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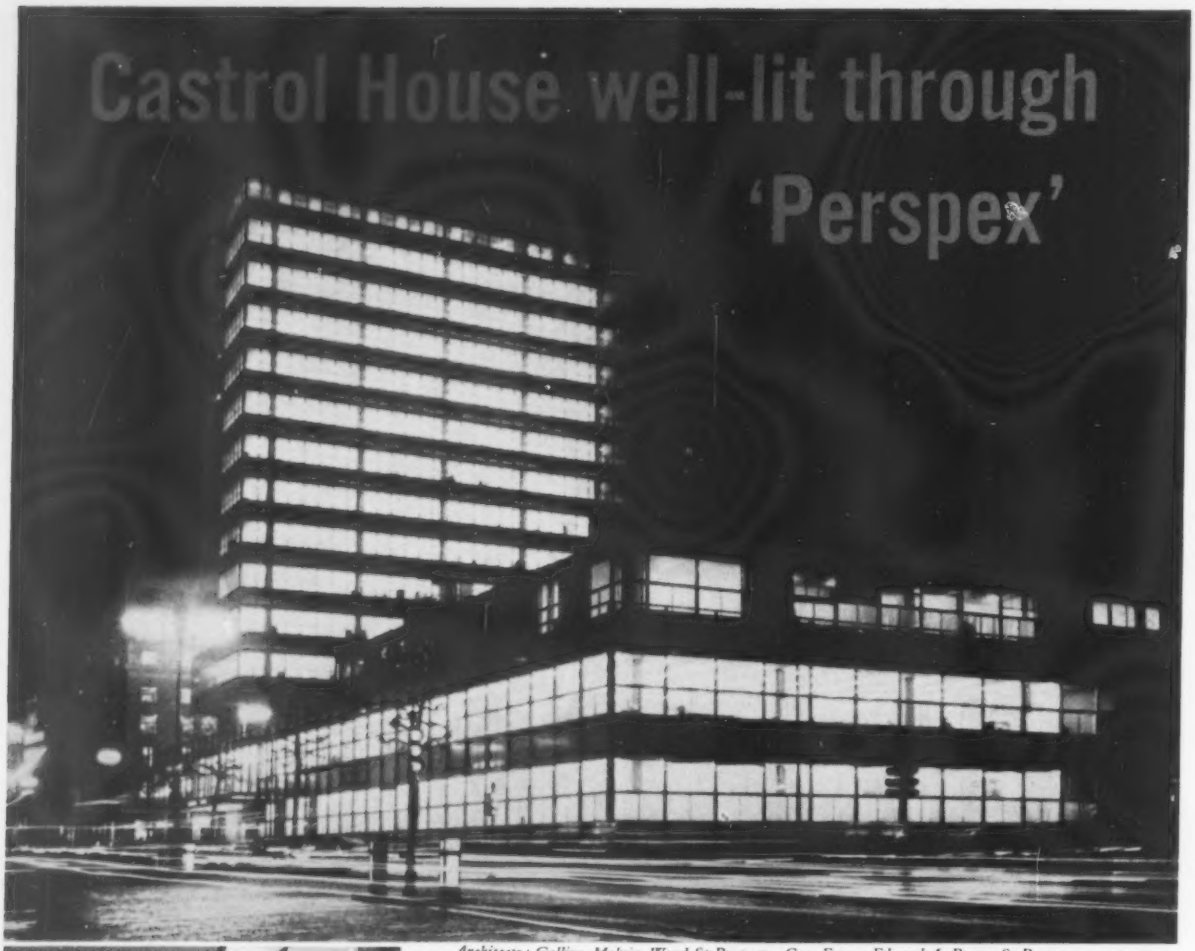
Light and Lighting

December 1960

Hospital design is undergoing a revolutionary change, of which one outcome is the provision of light and airy surroundings for patients, as indicated in this picture of a ward in Altrincham hospital, and in our feature starting on page 343.

Castrol House well-lit through 'Perspex'



Architects : Gollins, Melvin, Ward & Partners Con. Engs. : Edward A. Pearce & Partners

Exterior of Castrol House built for Castrol Limited, Marylebone Road, N.W.1, showing the very large installations of cold cathode fluorescent lighting fittings made by Ionlite Limited, Scrubs Lane, London, N.W.10. The continuous trough fittings all have diffusers made from diamond pattern 'Perspex' acrylic sheet.

The Vista Lounge on the top floor of Castrol House showing small ceiling lighting fittings moulded from 'Perspex' acrylic sheet by Frederick Thomas & Co., Stanhope St., London, N.W.1.

The DAEMPA ceilings throughout Castrol House are fitted with continuous trough cold cathode lighting with diffusers made from diamond pattern 'Perspex' acrylic sheet by Ionlite Limited, Scrubs Lane, London, N.W.10.

IONLITE LIMITED chose 'Perspex' acrylic sheet for the diffusers on the cold cathode lighting fittings recently installed in the 'Daempa' aluminium suspended ceilings in Castrol House. The covers are shaped from patterned 'Perspex' acrylic sheet, to diffuse the light and to secure a smooth integrated appearance throughout the installation. By using 'Perspex', Ionlite Limited were able to select, from the wide range of colours and finishes now available, the material best suited to the different types of fitting necessary in this installation. The use of 'Perspex' made it possible to produce these specially designed covers economically without high tool costs.

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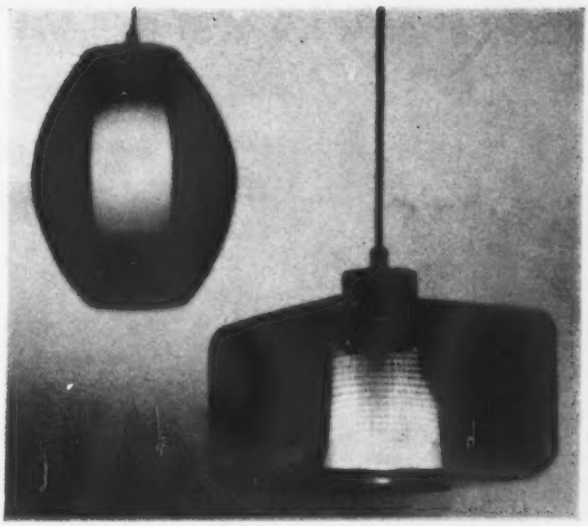

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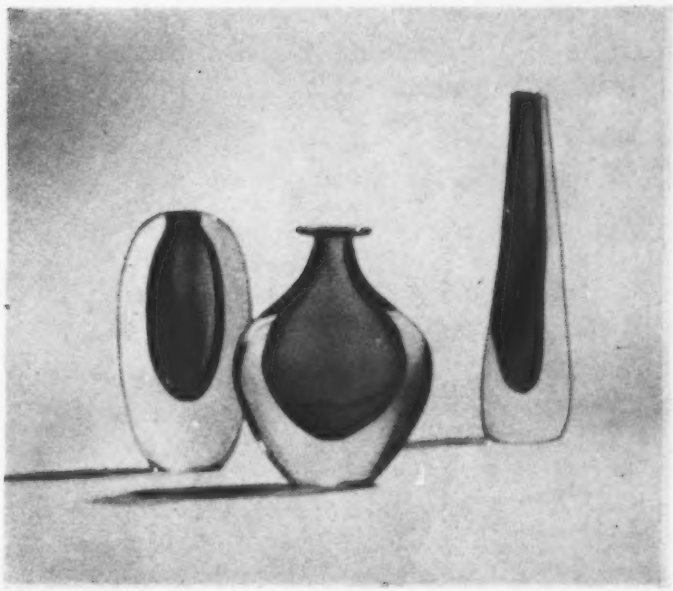

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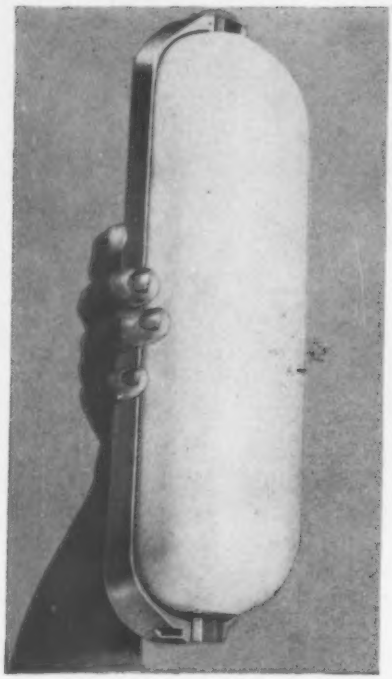

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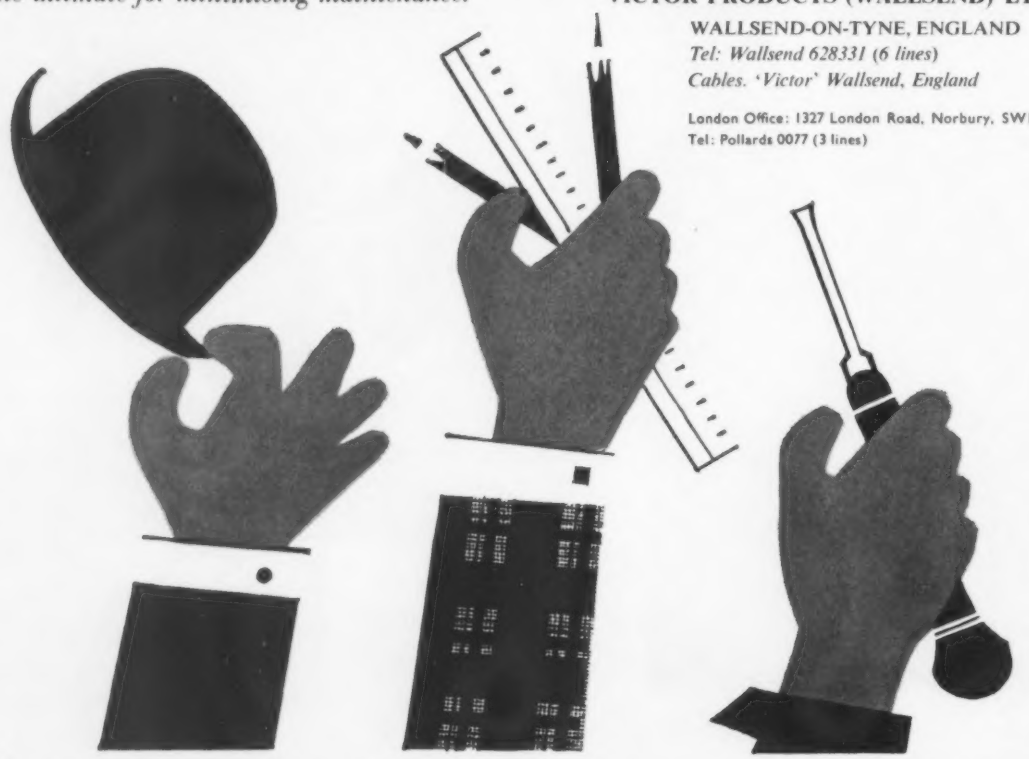

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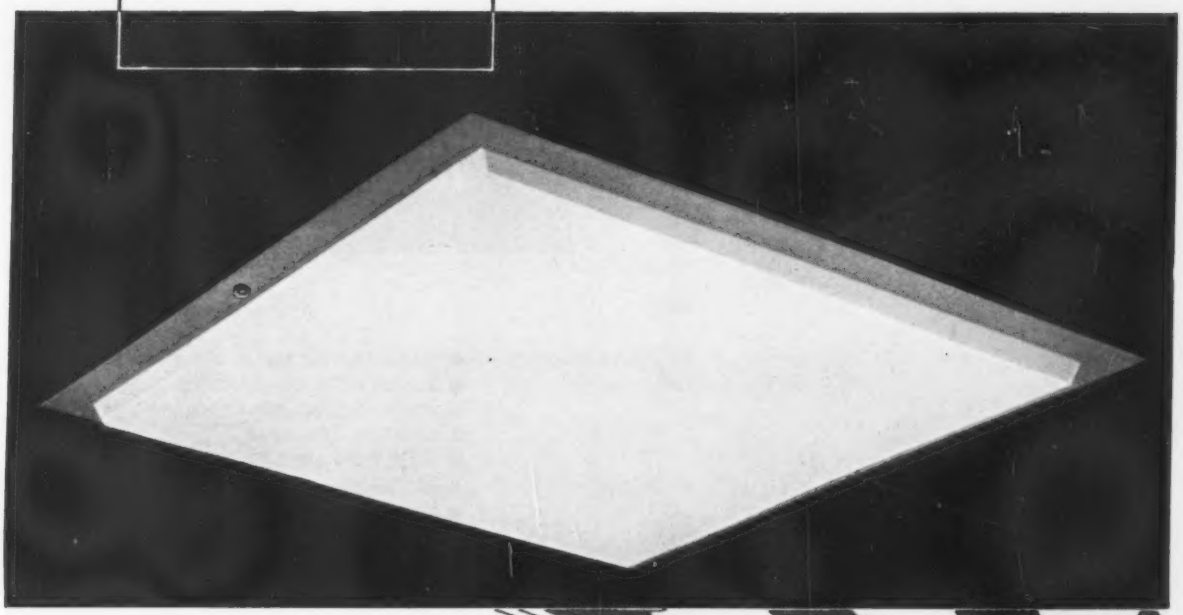

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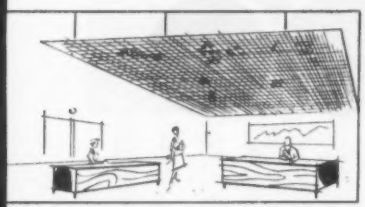

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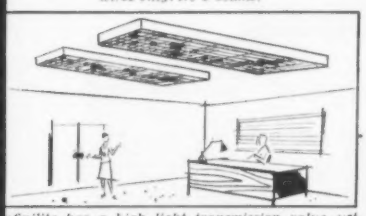

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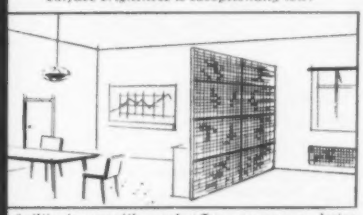

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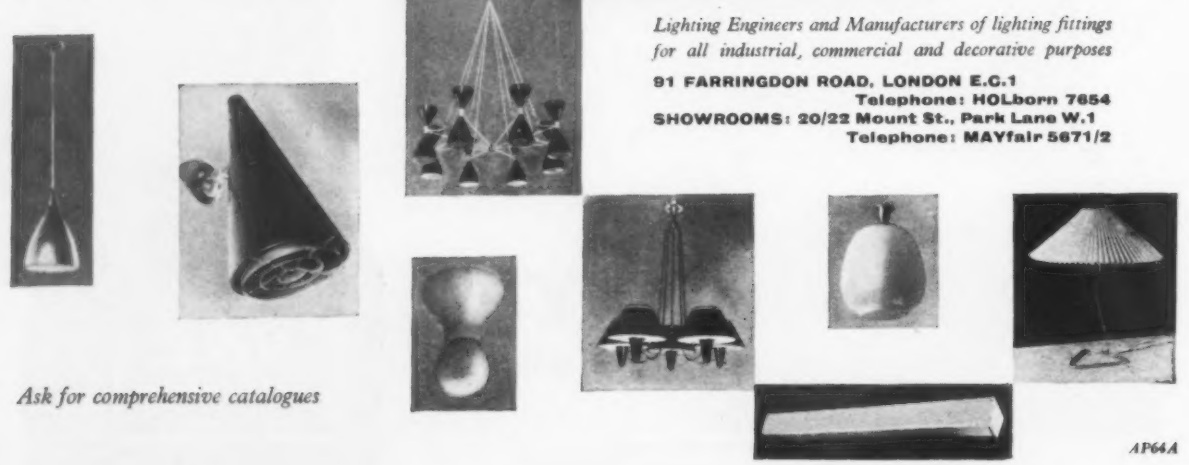

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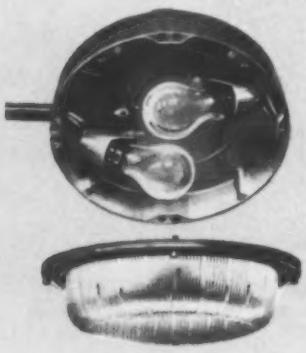

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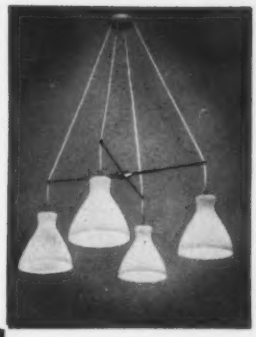

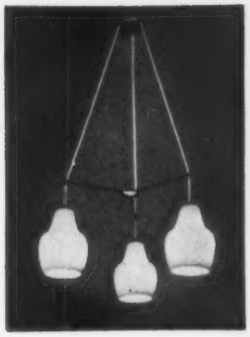

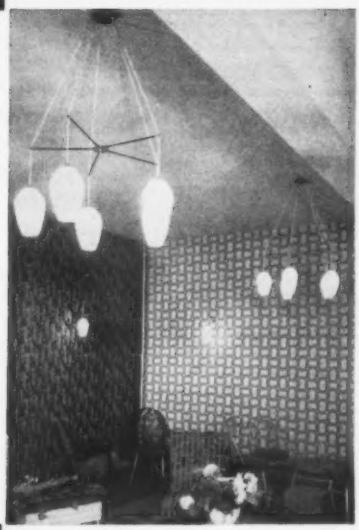

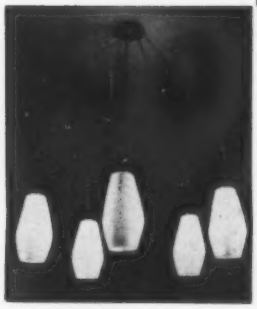

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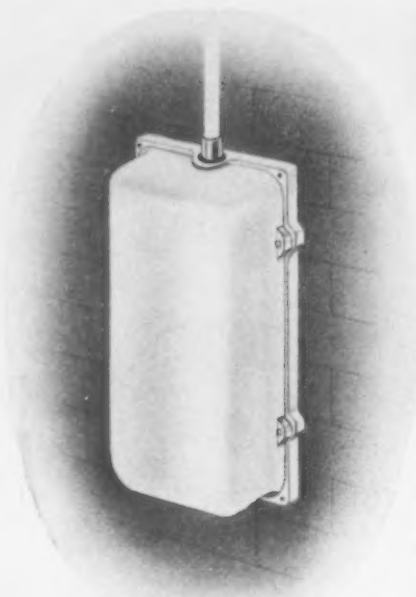

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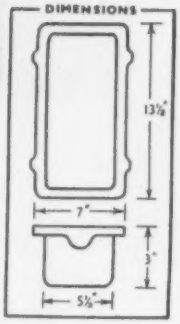

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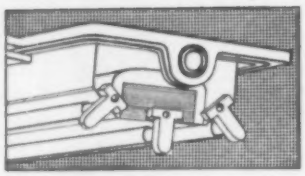

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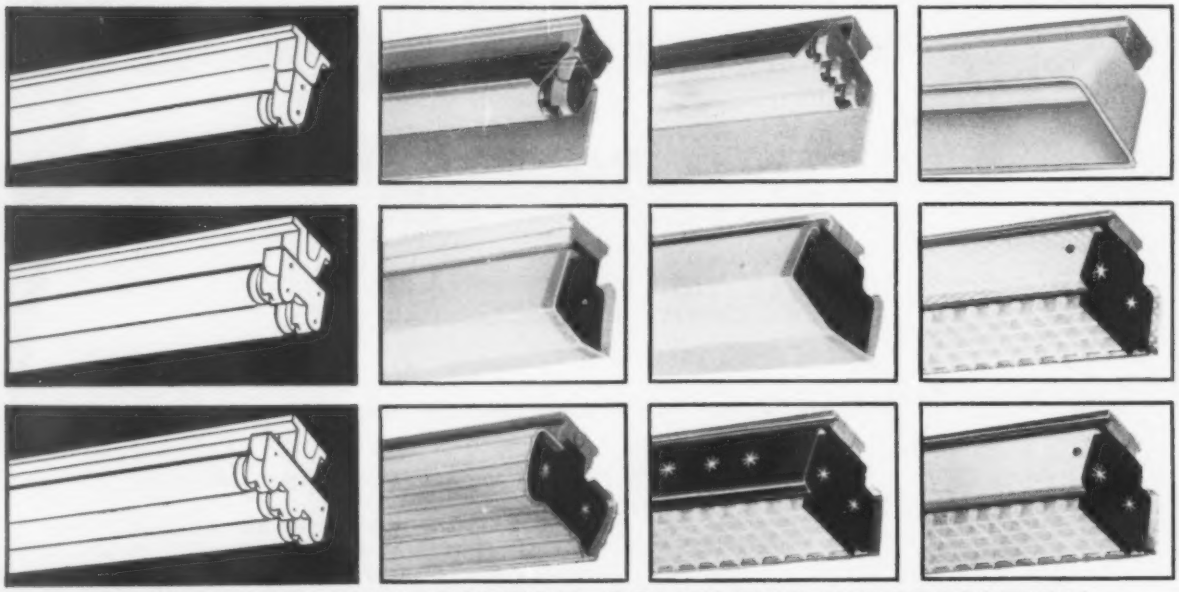

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Light and Lighting

Vol. 53 No. 12

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Lighting in Hospitals: A comprehensive feature in which Peter Stone briefly reviews the current building programme (**page 343**) and J. H. Gura discusses present-day ideas on the lighting of wards (**page 345**). Also included are articles on the lighting of operating theatres (**page 348**), on the installations in the new hospitals at Londonderry and Swindon (**page 351**) and on the lighting of corridors and circulation areas (**page 356**). Pictorial examples from Britain and overseas are given.

The Design of Filament Lamps: A study by F. J. G. Clack of the problems of lamp design, showing how the lamp maker is constantly faced with the need to compromise between conflicting requirements (**page 360**)

Lighting for Tile Production: Technical description by A. C. Holden of the redesigned lighting installation in a factory making ceramic tiles, indicating the improved production achieved (**page 364**)

A Palace on the Persian Gulf: British art and engineering have combined to produce a sheikh's palace in which indoor and outdoor lighting forms an integral part of the aesthetic design (**page 366**)

English Electric's New Office: Lighting features in the new EE headquarters building in London are briefly described (**page 370**)

Lighting Abstracts: A record of recently published works in lighting and allied subjects (**page 373**)

IES Activities: London sessional meeting on stage lighting equipment—Coming events (**page 374**)

Miscellany: Book review—Personal—Industrial notes—Overseas news—Situations (**page 374**)

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Hospital Lighting

Since the 'lady with the lamp' campaigned for better conditions in hospitals for the sick and injured, rather more than a century ago, a transformation has taken place. To Florence Nightingale the best of modern hospitals might well seem 'Paradise enow'. But, in the average hospital in this country, there is still room for improvement of lighting. Many hospital wards still retain their shallow conical reflectors which do little or nothing to screen the lamps themselves from the sight of the bedridden patients. It is true that some of these patients are accustomed to these anachronistic 'shades' in their own homes and are seemingly inured to the glare of semi-nude lamps. But things should be better than this in hospital wards and there is little doubt that patients would be visually more comfortable if better luminaires were installed. Nowhere is the need for the best attainable lighting more obvious than in operating theatres. Fifty years ago these were built with very large windows, free, as far as possible, from external obstructions. One of the latest of such theatres has no windows at all; it has skilfully designed artificial lighting that serves the surgeon well all round the clock. Of course there is a number of other places in hospital premises where the lighting should be above criticism—in laboratories, dispensaries and kitchens—and not least deserving of good lighting in their own quarters is the hard-working nursing and medical staff.

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In many people's minds, the surgical operation is the peak of drama in hospital life. As this picture of a theatre in London's St Thomas's hospital shows, it is also a severe visual task, for which the lighting provides assistance in creating the necessarily high level of illumination at the focal point and in the smooth reduction of intensity away from the operating area to avoid sudden brightness changes. On the opposite page are views of Paddington General, the new wing of St Bartholomew's and the West Cumberland hospitals.

(Photos: *Nursing Mirror*, Camera Press)

Lighting in hospitals

The building programme

by Peter Stone

DURING THE FIRST SEVEN YEARS OF THE NATIONAL HEALTH SERVICE, which threw the hospitals open to all, over £60 million was spent on repairs, adaptations, conversions and extensions. But no new building had been done since the war started, and it was not for sixteen years, in 1955, that the present hospital building programme began to take shape. In 1955/6 capital investment exceeded £10 million for the first time, and the figure has increased every year since. £22 million was spent in 1959/60; in 1960/1 £25½ million is being spent, and the estimate for 1961/2 is £31 million. Nearly 180 major building schemes, each costing at least £250,000, have been announced since 1955, including thirty-four new hospitals. Of these, seventeen have been planned, eight started, and nine are partly completed and in use. The first large building scheme from the centrally financed programme to be begun in London was the new out-patient department of the North Middlesex Hospital, work on which was started in 1957. Laying the foundation stone of another out-patient department at Nottingham the following year, Mr Walker-Smith, the Minister of Health, stressed the importance of out-patients' departments, one of the chief aims of the Ministry being to keep the patient, if possible, out of a hospital bed altogether. New schemes planned to start in 1961/2 include the complete rebuilding of St. Thomas's in its present site opposite the Houses of Parliament. Other plans to be put into operation next year (1961/2) are for a new hospital at Truro and a dental teaching hospital adjoining Birmingham Hospital. In May of this year (1960) it was accepted that the rising demand for architects must be accompanied by rising rewards, and a more generous scale was brought into effect. The highest salaries of regional architects and engineers were increased by £1,045 to £3,400; those of their deputies were increased by £695 to £2,365; principal assistant architects, engineers and surveyors went up by £625 to £2,135; senior assistant architects and surveyors by £355 to £1,600; assistant architects and surveyors by £255 to £1,310; and a new engineering general grade was established with a ceiling of £1,600. In addition, Regional Boards were authorized to advertise for assistant regional architects to be responsible for major schemes of £1 million or more; and the Ministry itself took on twelve new architects and surveyors and appointed Mr Tatton Brown chief architect. Courses in hospital design and planning have been held, one by the Royal Institute of British Architects and another by the Nuffield Foundation. The Ministry threw the design of the new Cardiff teaching hospital open to competition and is satisfied that the winning design, with 650 beds and medical and dental schools, is 'dignified and economical'. A similar competition is being held for the new hospital with 474 beds at Boston.

Details of the building programme, listing hospitals partially completed and now in use. Hospitals in building, and future plans, are given on page 358.

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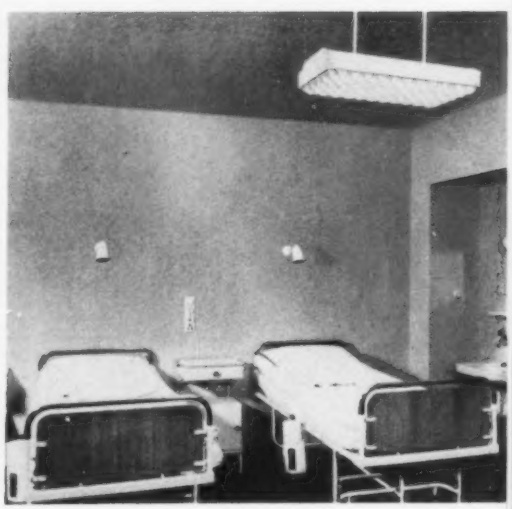
Contrasting ideas on general and local lighting for wards are shown in these views of 1, part of a seven-bed ward in the new maternity department of Workington infirmary; 2, a dormitory in a mental hospital; 3, children's ward in a north London hospital; 4, one of the children's wards in Altnagelvin hospital; 5, a ward in Leverkusen hospital, Germany—the louvred fluorescent fitting has two 20W tubes, the adjustable wall brackets 25W filament lamps.

(Photos: *Nursing Mirror*, *Interior Design*, Sam Lambert, Siemens-Schuckert)



WARD LIGHTING

Examples

HOSPITAL LIGHTING

In the Wards

By J. H. Gura* AMIEE

THOUGH THERE ARE SOME OF US who have escaped an extended stay in a hospital ward, there are very few who have not spent an hour or two in a ward and there can be little disagreement that anything which can be done to improve the 'institutional' atmosphere of the hospital environment and improve the amenities is highly desirable. The present time, when a great number of new hospital buildings are being actively planned and old buildings are being improved, is highly opportune to consider such improvements. It is certain that if in the next ten years or so we do not make the best of our opportunity a great deal will have been lost for generations to come.

There are many facets to the design of a ward unit, numerous people are involved, and it is probably true that the plan is the most important of all. Nevertheless the lighting engineer's contribution to the scheme is vital to its success or otherwise.

The Problem

In examining the question of lighting for hospital wards it is necessary as always to assess the problem in terms of detailed requirements, and in doing so it immediately becomes obvious that the lighting problem is of considerable complexity because of the number and variations of requirements and the contradictions between the needs of patients and staff.

To the patient the ward is both living room and bedroom in which perhaps some therapeutical work is done. The nursing staff, on the other hand, carry out a high proportion of their duties in the ward, and in this respect the ward must be considered a place of work. In addition the medical staff must be capable of examining the patients properly.

Before proceeding further it must be mentioned that a number of these problems can be eased, to a degree, in modern hospitals by planning to separate some of the functions, e.g. by the provision of day-rooms, the removal of patients to treatment rooms, etc. but since few of these facilities exist generally it is assumed that all the various functions are to be carried out within the wards and that the ward is a multi-patient unit of four beds or more.

A short examination of almost any ward in existence will make it apparent that for the patient in a 'lying' position the surface brightness, however low it may be, of any translucent fitting is unacceptable; it should, therefore, be a fundamental principle of any design to ensure that the patients cannot see in any normal position the source of light or any indirectly illuminated high brightness surface.

A second factor apparent with existing installations is that they are extremely inflexible. Generally they consist of a line of suspended fittings down the centre of the ward coupled with individually controlled bedhead fittings for each patient. Since the use of the bedhead lighting without the general lighting (after dark) leads to bad contrast levels, it is in such circumstances uncomfortable. The lighting, therefore, tends to be 'all on' or 'all off'. However, activity in a ward is at least as varied as in the home and it is clear that while, for example, at mealtimes a higher level of illumination is necessary, at times of relaxation, say between dinner and lights out, a lower level of illumination in an interesting form would be a substantial amenity. This cannot be achieved satisfactorily merely by the selective switching of a row of suspended fittings.

The next basic problem to be considered is the source of light in general. In the past the medical profession has been particularly prejudiced against the use of fluorescent lamps, and it must be said for substantial reasons. The appearance of a patient is of considerable consequence both for examination purposes and for his own well-being. Now, however, there is an extremely wide range of colours available with fluorescent lamps, and recent experiences show that doctors are now finding colours to their liking and this source of light fully acceptable. The designer should therefore now consider himself free to utilise fluorescent lamps wherever he considers them for any reason desirable. In particular, it must be borne in mind that if schemes giving higher levels of illumination and greater flexibility are to be provided, it will be essential to counter the additional capital costs with the savings on the wiring and running costs consequent upon the use of the fluorescent lamp as the light source.

A Solution

Having established the basic principles to be followed, the requirements and design can now be examined in some detail. In the nature of the problem each of the various aspects will need to be considered separately and may, therefore, appear somewhat disjointed until the whole ward has been dealt with.

Central area

The area between the bed ends, i.e. the central area, is the area of maximum activity for both the staff and the ambulant patients. The nursing staff have to serve food, medicines, etc. from trolleys in this area and ambulant patients may spend much of the day at tables in the area. In addition, the lighting here can be considered as the principal source of general lighting for the ward.

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Lighting equipment at Musgrave Park hospital, Belfast, designed by the Nuffield Foundation Division for Architecture jointly with the Building Research Station. The aluminium drums are finished matt externally, white internally. The level of illumination is 10 lm ft^2 in the centre of the ward falling to 3 lm ft^2 on the bed where the lighting is supplemented by 'Anglepoise' fittings.

It has already been established that the source of any lighting provided must not be visible directly or indirectly to the patient in bed, and if the worst case is to be considered then the location and design of the lighting units must take into account the patient in the 'lying' position. In order to meet this requirement it is necessary that any source of lighting in front of the patient should be (*a*) at the lowest practical angle to his horizontal line of vision, and (*b*) fully screened from his line of vision by opaque material.

This means that the fittings must be suspended along the centre line of the ward, i.e. the furthest point possible for the patients either side of it, and must be at the minimum height practicable. The fitting should be designed with completely opaque sides and with minimum obstruction to upward and downward light. In order to ensure absolute cut-off of the light source, the lamps should be fixed at high level within the fitting, and in consequence there would be a greater element of upward light to the ceiling (i.e. indirect lighting) than downward lighting. The downward element,

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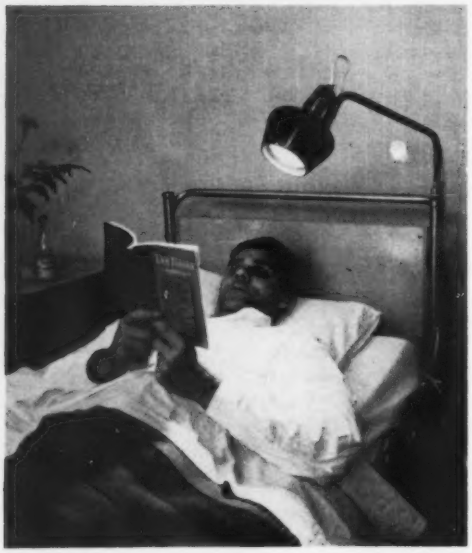

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British and overseas ideas for bedhead lighting: 1, a simple 'saucer-shaped' unit from America; 2, dual purpose fluorescent fittings in Nördlingen hospital, Germany—they house two 20W tubes and incorporate adjustable shutters to vary the amounts of light directed upwards and downwards; 3, this Swedish fitting has one 40W lamp for reading and one 5W lamp for night lighting; 4, another Swedish idea, used at Björnbo hospital, Lidingö; 5, drum-type fitting by Frederick Thomas; 6, dual-purpose Swedish fitting, giving both general and bedhead lighting; 7, 8, two adjustable fittings, also by Frederick Thomas.

(Photos: Siemens-Schuckert; *Ljuskultur*)

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WARD LIGHTING : BEDHEAD FITTINGS

however, would be concentrated on a comparatively smaller area, the illumination level in this area being considerably higher than the average for the ward but tending to fall off sharply over the bed areas.

Bedhead lighting

The next point to be considered is the much discussed problem of the bedhead lighting unit. Originally it was accepted general practice to use an opal glass shade enclosing a tungsten lamp for this purpose and though it gave a fairly satisfactory result in the area of the patient, brightness made it objectionable to patients on the opposite side of the ward.

In recent installations the brightness problem has been overcome by enclosing the lamp in a metal reflector of one form or another. The result has been to provide the patient with a highly concentrated source of lighting, in some cases with only slight variability of control and invariably mounted to one side of the bed. The incapacities of the patient are, of course, infinitely variable and it is obvious that even when mounted in the most flexible manner possible, such as the sprung or counter-balanced arm, a concentrated local source of light has limitations, and in some cases must be seriously inconvenient to the patient.

What appears to be required is a diffused source of light which will provide an adequate level of illumination over the top half of the bed and which is relatively unobstructed by the patient regardless of his position, but which is still local to each patient without inconvenience to other patients. To meet all these requirements the source of light should be of large dimensions, and the fluorescent lamp is an obvious choice. It should be mounted above the patient rather than behind him, and should be efficiently skirted to prevent any significant horizontal element in the distribution. It is evident that to do this the housing to the fitting should comprise a form of canopy above the bedhead, fixed to the wall and projecting out from it by about eighteen inches or so, and at a height of about six feet from the floor. Such a canopy should not present any serious difficulties in design and could form the upper extremity of a comprehensively designed bedhead unit. Properly designed, such a fitting could well be simpler to maintain from the cleanliness point of view than many of the complicated tungsten brackets now being installed.

Having provided such a canopy it is clear that it can be further utilized in a wide variety of ways. First it can house a source (or sources) of light for the use of doctors or nurses in the examination of patients. A fluorescent lamp could be mounted in an angled reflector in the front face of the canopy to illuminate the entire length of the bed for this purpose. Alternatively, or additionally, a concentrated form of lighting could be attached, but since this would only occasionally be required in the ward it might be better and more economical to provide a mobile fitting for this purpose. This lighting would not require screening from other patients as its use is usually limited to short periods. If an examination is to be prolonged then it would generally be conducted behind a curtain screen.

The canopy could also be used to provide a housing for additional indirect general lighting by enclosing lamps within the top surface giving an entirely indirect distribution via the walls and ceiling. This lighting could supplement the principal general lighting to provide a better general distribution of illumination throughout the ward, whilst by itself it could provide that 'soft' form of alternative lighting for periods of relaxation referred to earlier.

Night lighting

All the principal lighting requirements have now been met with the exception of 'night lighting'. For this purpose a minimum of light has to be provided to facilitate movement. Some recent installations have made use of a flush tungsten fitting in the wall located some 12 in. above floor level and fitted with downward facing louvers. This unit has been found to provide the illumination necessary with the minimum of inconvenience to the patients. To attend to patients after 'lights out' it is necessary at times to switch-on the patient's bedhead lighting and for this purpose some form of dimmer control to this point would be a useful refinement.

Illumination Levels

In the past recommended illumination levels for ward lighting have been extremely low. It is probable that this may have been due to the problems encountered with glare and contrast. However, today the population is living in an environment of ever increasing levels of illumination, whilst new hospital buildings provide for much higher levels of daylighting. There is, therefore, no valid reason to prevent reasonable increases in illumination levels. It is suggested that with the kind of scheme outlined, neglecting bedhead lights, the dual system of general lighting should provide alternative levels of at least 5 and 10 lm/ft^2 average over the ward. At the higher level peak values would automatically occur in the space between the bed ends where it is required. The bedhead lighting should be at a level of not less than 20 lm/ft^2 to ensure visual comfort for such tasks as reading, writing, occupational therapy, etc. Examination lighting should be at a similar level.

A factor which will seriously affect the illumination will be the colours chosen by the architect for his walls and ceilings. There has been a marked tendency recently to use colours of low reflection factor. While the varied use of colour is generally to be welcomed, with a lighting scheme of the type described which has a high element of indirect lighting it is essential that colours chosen for the ceilings and walls, particularly those behind patients, have a high reflection factor. At the same time the surfaces should be as matt as possible to prevent reflected brightness.

Cost

Finally the vexed question of cost. Is the type of scheme envisaged in this article over elaborate and too costly to be practical?

Examining the scheme proposed it can be seen that nothing revolutionary has been propounded. The requirements have been examined in detail, and a scheme has been formulated by the application of known principles which is simple, direct and devoid of any structural complications and without extravagance. Furthermore, it can be applied as easily to existing buildings as to new hospitals.

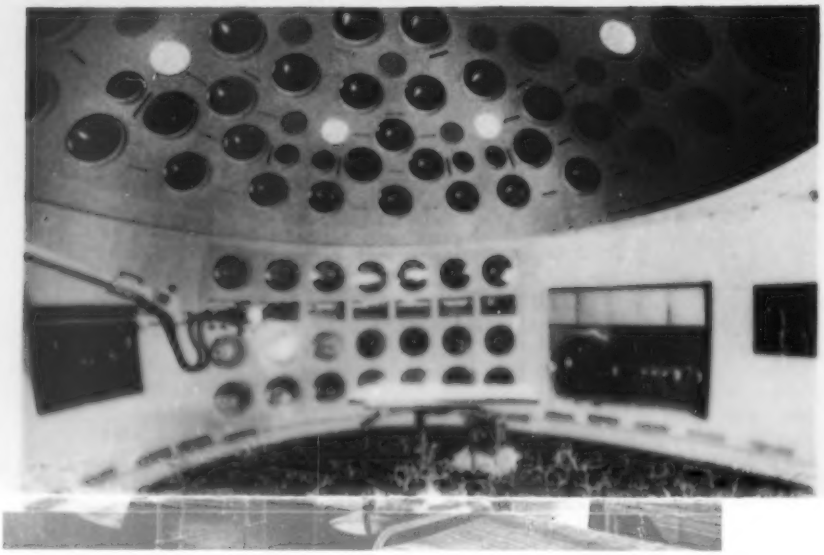
The only extra cost involved over and above accepted practice arises out of the substitution of the multi-purpose canopy for the adjustable type of bedhead lighting unit now commonly used. If the canopy unit were to be simply designed and produced in quantity there is no reason to suppose that it would cost more than something of the order of an additional £25–30 per bed. New hospitals now being built will cost a total of something like £6,000 per bed. The ward is the heart and core of the hospital wherein live most of its population most of the time. It is for others to say whether an important advance in the efficiency and amenity of the ward is worth an increased expenditure of this order.

Swedish method of providing night-time lighting, the lamp incorporated in a movable bed-head unit to which is also attached an adjustable arm carrying the reading lamp.

(Photo: *Ljuskultur*)

HOSPITAL LIGHTING

NEUROSURGICAL THEATRE, EDINBURGH



In the operating theatre

FOR MOST SURGICAL OPERATIONS the need is for a readily controlled 7 to 9 in. dia. circle of light, shadowless and deeply penetrating, with an intensity of between 2,000 and 3,000 lm/ft² (though in the MOH Hospital Building Bulletin No. 1 it is suggested that there is little advantage of going above 1,000 lm/ft², on the grounds that visual acuity at these levels is extremely low). Until recently the only way of satisfying this requirement was by one or other of the local-lighting fittings on the market. These fittings are of two distinct types and there

WARD LIGHTING

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supersede the local fittings in other types of theatre, but there are two snags: cost and radiant heat. When it is appreciated that general lighting alone may require several kW of electricity—at the Princess Margaret Hospital, Swindon, the general-lighting load in the operating theatre is 6·1 W/ft²—it will be realized that any increase in the wattage used for local lighting may create a serious heat problem. The comfort of the surgeon, who may be operating without a break for eight or more hours, is extremely important and air-conditioning can only help to a limited extent as we are concerned here with *radiant* heat. (In any case, the MOH does not usually sanction the cost of refrigeration plant.)

The wattage can be reduced, of course, by using fluorescent lamps for the general lighting, though here one meets resistance from the anaesthetists, who are accustomed to observing their patients' faces and hands only by natural or tungsten lighting. Anaesthetists are, however, gradually being won over to fluorescent lighting and the future will no doubt bring the increasing use of this light source in both operating theatres and anaesthetists' rooms—preferably in recessed fittings to which access is

continued from opposite page

Each theatre is equipped with sixty-eight projectors, designed to direct a converging beam of light on to the operating point, minimizing obstruction from the surgeon's head and hands, and exhibiting no glare when viewed from outside the beam. The effect is achieved by using special 75 w, 50 v, internally silvered lamps with pre-focus caps, fitted into reflectors made to high accuracy from super-purity anodized aluminium, and fitted and removed from above the ceiling. Once the lamp has been focused and the reflector inclination set, the lamp may be removed without disturbing the setting. The heating effect is eliminated by fitting Calorex glass filters to absorb infra-red radiation.

For most operations, only about twelve projectors need to be alight, giving an intensity of illumination in excess of 2,000 lm ft² at the operating point. The direction of the lighting is changed by re-arranging the pattern of lighted projectors, which is effected from a magnetic switch controller installed in the theatre wall.

The only visible part of the controller is a flat steel plate flush with the wall, on which is engraved the outline of the dome ceiling with a rectangular extension representing the additional projectors in the end wall. Concealed behind the plate are switches arranged in rows corresponding to the projector layout, each switch comprising a pivoted bracket carrying a permanent magnet and mercury switch. By placing a flat ferrous metal plate on the theatre side of the panel, the magnets within its area are attracted to it, swinging the mercury switch to the 'on' position and holding the plate against the panel face. The size and shape of the plate can be varied to light any number or pattern of projectors; a crescent shape will give a similar lighted pattern on the ceiling and will also minimize shadowing caused by the surgeon's head.

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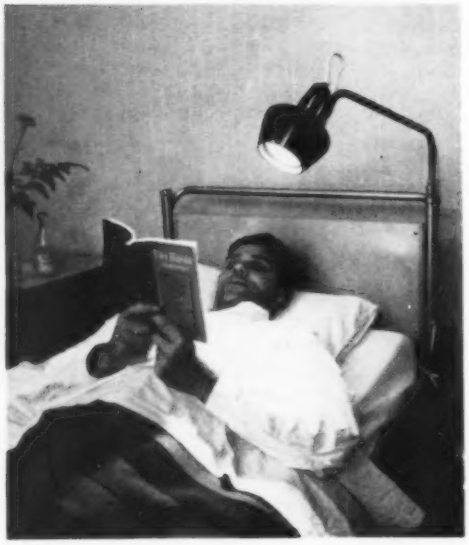

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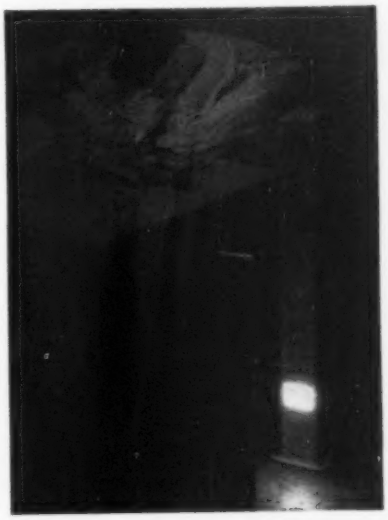
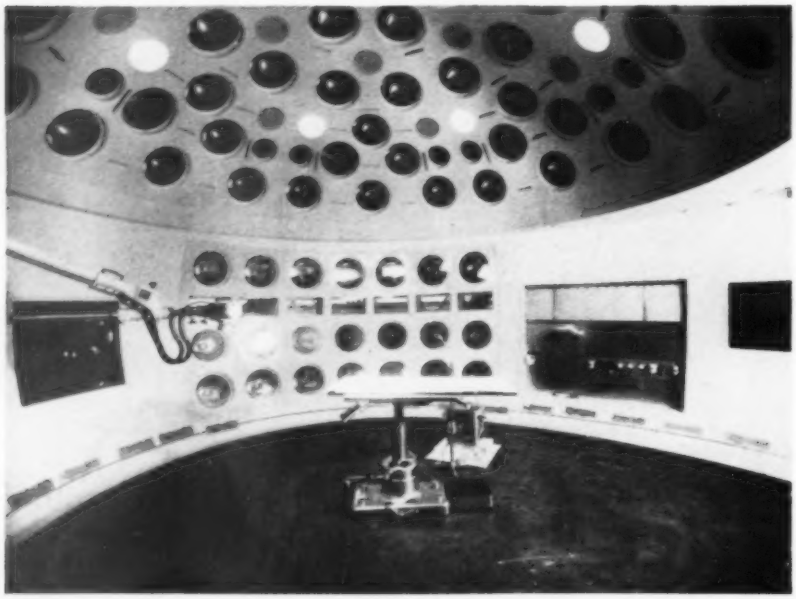


Swedish method of providing night-time lighting, the lamp incorporated in a movable bed-head unit to which is also attached an adjustable arm carrying the reading lamp.

(Photo: *Ljuskultur*)

HOSPITAL LIGHTING

NEUROSURGICAL THEATRE, EDINBURGH



LATEST IDEAS ON THE DESIGN of operating theatres to increase even further the standard of sterile and aseptic conditions are to be seen in two new theatres at Western General Hospital, Edinburgh, where the lighting equipment has been affected considerably by these anti-infection considerations. Illustrated in Fig. 1, the theatres are the result of the closest co-operation between surgeons, architects, consultants engineers and lighting engineers.

The main features of the design are:

1. Adequate space to give freedom of movement for staff and traffic.
2. Elimination of all dust collecting surfaces.
3. Removal of as much atmospheric dust as possible by means of air conditioning designed to create a blanket of air flowing from ceiling to floor to assist the gravitational fall of dust, the incoming air being cleaned, filtered and controlled in humidity and temperature, and the ventilation maintaining an internal pressure slightly above ambient to inhibit air entry through other means.
4. High intensity lighting to be provided without heating from outside the theatre, the direction of lighting to be easily adjustable from within the theatre but its maintenance and switching to be effected outside.
5. As much electrical apparatus as possible to be outside the theatre to reduce the risk of anaesthetic explosion.
6. Students' viewing gallery to be outside the theatre.

To achieve these aims has produced a unique theatre design, in which the ceiling is a hollow dome acting as an air duct over the entire room area with ventilating inlet slots in the theatre face. The dome is fabricated from inner and outer shells of aluminium, into which have been welded through tubes to house projector and general lighting fittings and viewing portholes. A similar construction is adopted for one end wall to provide additional lighting.

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In the operating theatre

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The multi-lamp fitting—a circle of between five and nine spotlamps recessed into a concave disc—was first developed in the 1930s. It has one main advantage—that, if one lamp fails, the surgeon still has the use of the others and the lighting is only affected to a small degree. With the more recently developed single-lamp fitting (usually a low-wattage lamp in a large parabolic reflector) the failure of the lamp leaves the surgeon only with the rather different form of light provided by three auxiliary internally-silvered spotlamps. Another advantage of the multi-lamp fitting is that a central aperture can be used for a camera or for closed-circuit television. The principal advantage claimed for the single-lamp fitting is that its hollow cone of light is less interrupted by the intrusion of the surgeon's head than is usual with multi-lamp fittings.

Recent improvements in both types of fitting have in the main been concerned with increasing the light intensities (from a maximum of about 600 lm/ft² before the war to a range of intensities up to 5,000 lm/ft² today) and with simplifying the focusing and suspension arrangements. The old-fashioned travelling rail—still found in many hospitals—is a scandalous dust trap and the modern articulated boom is an enormous improvement on this account, as well as giving a greater range of movement.

In theatres for brain surgery the maintenance of sterile conditions is of vital importance: hence the use in the Western General neurosurgical theatres of long-distance projectors recessed into walls and ceiling. It is widely thought that—in a simplified form—this system will gradually

supersede the local fittings in other types of theatre, but there are two snags: cost and radiant heat. When it is appreciated that general lighting alone may require several kW of electricity—at the Princess Margaret Hospital, Swindon, the general-lighting load in the operating theatre is 6·1 W ft²—it will be realized that any increase in the wattage used for local lighting may create a serious heat problem. The comfort of the surgeon, who may be operating without a break for eight or more hours, is extremely important and air-conditioning can only help to a limited extent as we are concerned here with *radiant* heat. (In any case, the MOH does not usually sanction the cost of refrigeration plant.)

The wattage can be reduced, of course, by using fluorescent lamps for the general lighting, though here one meets resistance from the anaesthetists, who are accustomed to observing their patients' faces and hands only by natural or tungsten lighting. Anaesthetists are, however, gradually being won over to fluorescent lighting and the future will no doubt bring the increasing use of this light source in both operating theatres and anaesthetists' rooms—preferably in recessed fittings to which access is gained from above the ceiling. (Fluorescent lighting has been used also for the lighting of the table itself. A fitting is available giving an illuminated area about 15 in. wide and 8 ft long, suitable for orthopaedic and skin work. The intensity, however, is only about 480 lm/ft²—the maximum possible with present lamps—and the penetration is insufficient for deep cavity work.)

With regard to the level of general lighting, current opinion calls for between 30 and 45 lm/ft². The MOH Bulletin suggests a figure of 30 lm/ft², but some people consider that this gives too great a contrast between the levels of local and general lighting. At Swindon, the tungsten fittings are arranged to give about 33 lm/ft² at a distance of 8 ft from the table, rising to about 43 lm/ft² at the table itself (these figures being measured, of course, with the table light switched off).

Some surgeons, however, find a high level of general lighting distracting and a few like to work with none at all. Spotlights recessed deeply into the ceiling might be a good method of providing a reasonable degree of general lighting without the surgeons being aware of it. On the other hand it has been suggested that indirect lighting of walls and/or ceiling would be the ideal way of providing glare-free general illumination. But, in the final analysis, as with the choice of lighting method for the operating table, it is the surgeon himself who must decide. As a lighting engineer who specializes in the design of schemes for operating theatres put it to us: 'Whatever my opinion might be, if I were having an operation myself, I would want the surgeon to have the lighting he liked rather than the lighting I think he ought to like!'

continued from opposite page

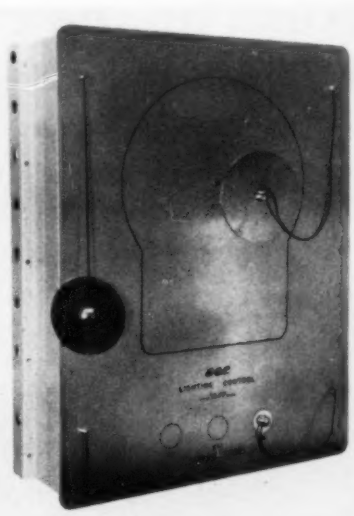
Each theatre is equipped with sixty-eight projectors, designed to direct a converging beam of light on to the operating point, minimizing obstruction from the surgeon's head and hands, and exhibiting no glare when viewed from outside the beam. The effect is achieved by using special 75 w, 50 v, internally silvered lamps with pre-focus caps, fitted into reflectors made to high accuracy from super-purity anodized aluminium, and fitted and removed from above the ceiling. Once the lamp has been focused and the reflector inclination set, the lamp may be removed without disturbing the setting. The heating effect is eliminated by fitting Calorex glass filters to absorb infra-red radiation.

For most operations, only about twelve projectors need to be alight, giving an intensity of illumination in excess of 2,000 lm ft² at the operating point. The direction of the lighting is changed by re-arranging the pattern of lighted projectors, which is effected from a magnetic switch controller installed in the theatre wall.

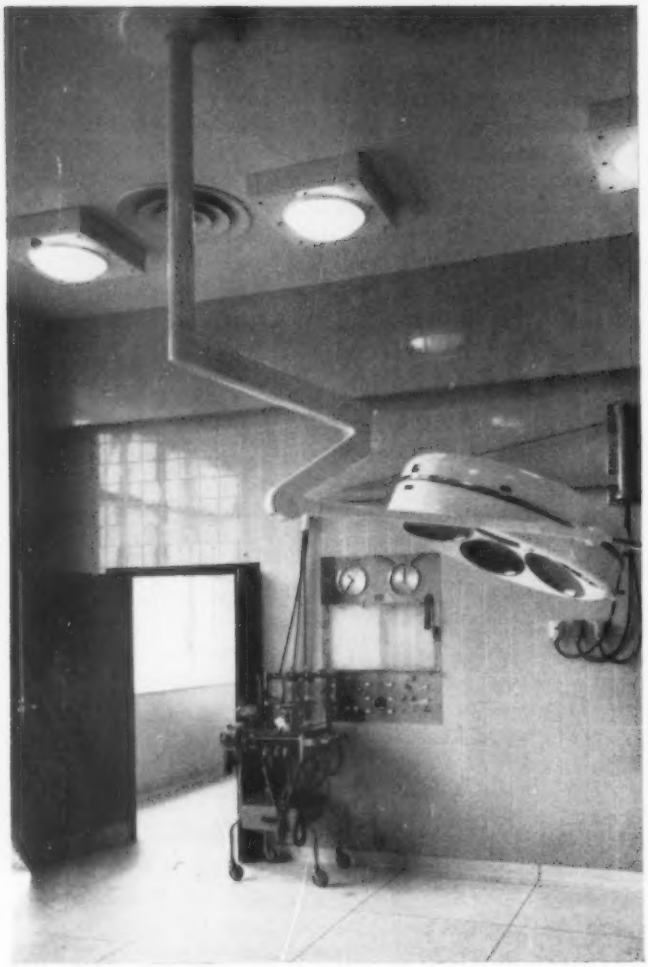
The only visible part of the controller is a flat steel plate flush with the wall, on which is engraved the outline of the dome ceiling with a rectangular extension representing the additional projectors in the end wall. Concealed behind the plate are switches arranged in rows corresponding to the projector layout, each switch comprising a pivoted bracket carrying a permanent magnet and mercury switch. By placing a flat ferrous metal plate on the theatre side of the panel, the magnets within its area are attracted to it, swinging the mercury switch to the 'on' position and holding the plate against the panel face. The size and shape of the plate can be varied to light any number or pattern of projectors; a crescent shape will give a similar lighted pattern on the ceiling and will also minimize shadowing caused by the surgeon's head.

Similar magnetic switches are used to control the eighteen general-lighting fittings, which can be switched to two intensities. All lamps are supplied at 50 v, a.c., and are switched automatically to a battery supply in the event of power failure until the standby diesel generator comes into operation.

The theatres were designed for Professor N. McO. Dott by John Holt, FRIBA, FRIAS, AMTPI; consulting engineers were Donald Smith, Seymour and Rooley, of Glasgow; lighting equipment was supplied by the General Electric Co Ltd.



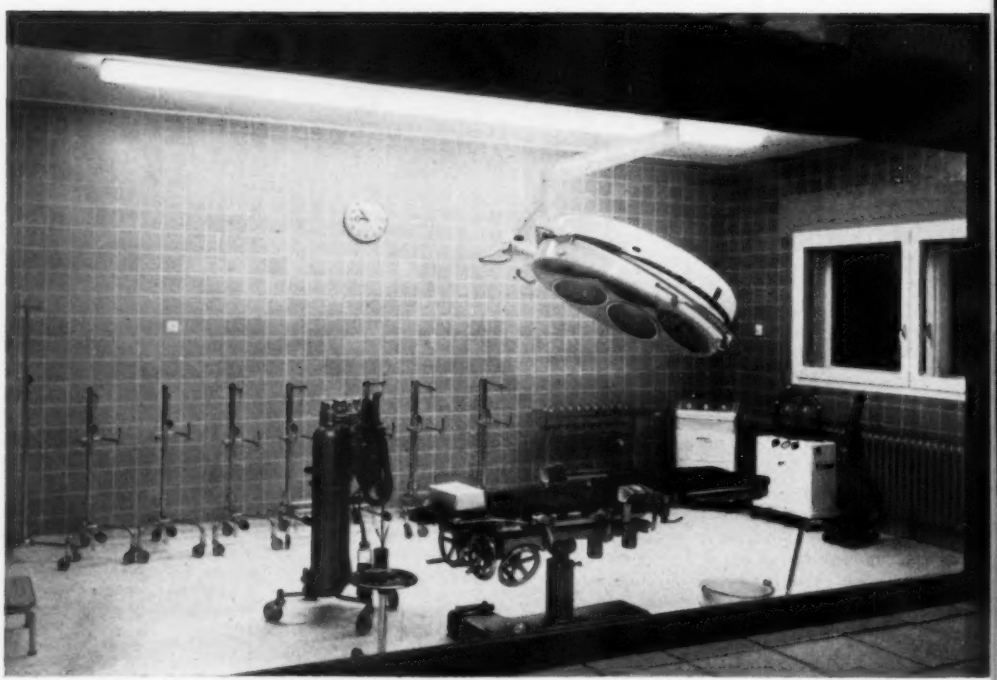
On the opposite page is seen the new operating theatre for brain surgery at Western General, Edinburgh, with the ceiling apertures for lighting fittings, viewing ports and ventilation slots making an unusual visual pattern in themselves. Above, left, is seen the magnetic controller for the lighting; all that is visible once the unit has been installed is the front plate, over which metal discs are moved to actuate the magnet arms of the switches behind the plate. Above, right, shows the method of gaining access to the lighting equipment; the ceiling is of shell construction, its two skins creating a ventilating duct.



OPERATING THEATRES: Examples

Above, left, is one of the 'Super Hanalux' theatre fittings installed in an operating theatre for septic maternity cases at Altnagelvin hospital. Above, right, a GEC operating theatre fitting in St Thomas's hospital. On the immediate right is another 'Super Hanalux' fitting, but in Erlenbach hospital, Germany. Note also the use of fluorescent fittings (twin 40W units) for the general lighting. The picture is taken through the glass wall provided for viewing by medical students.

(Photos: Sam Lambert, Siemens-Schuckert)



Two hospitals compared

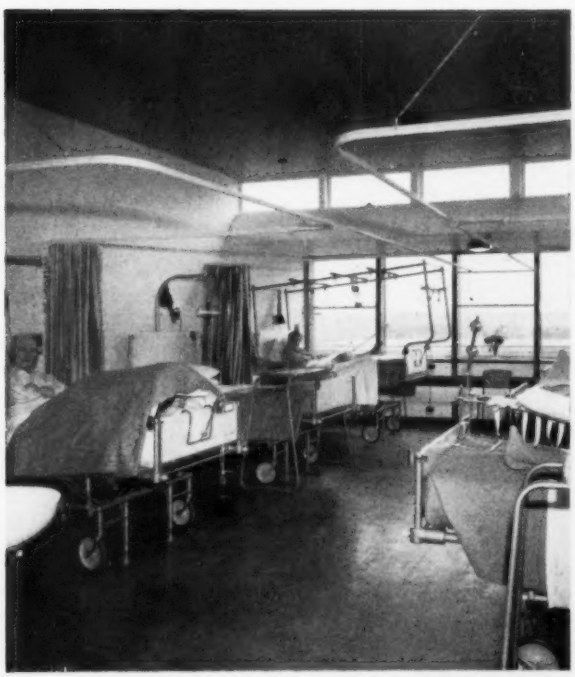
Above, left, the ward block of Altnagelvin hospital, Londonderry, contrasted with, right, the canopy fronting the entrance to Princess Margaret hospital, Swindon, which, incidentally, is lighted from fittings mounted in the paving. Below are contrasting views of the wards: left is the temporary ward at Swindon, lighted by louvred drum fittings mounted on the ceiling; right, a ward at Altnagelvin, using special diffusing acrylic cylinders.

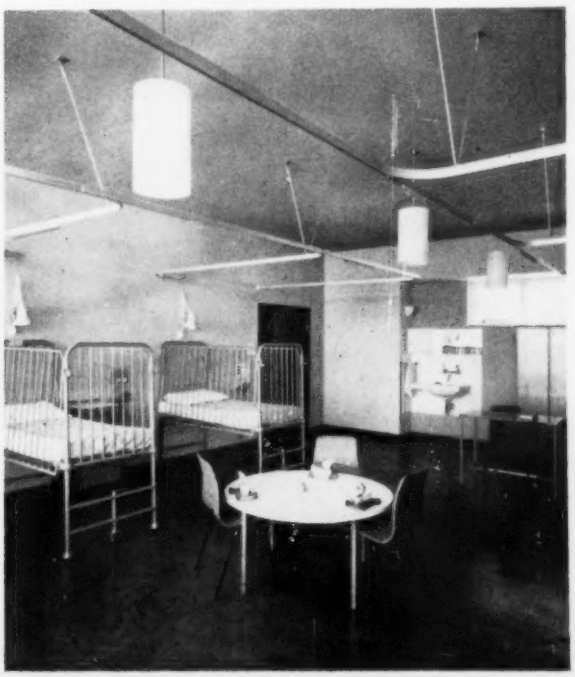
(Photos: Sam Lambert, de Burgh Galwey, *Architects' Journal*)

THE TWO HOSPITALS to have been designed and built in Britain since the war—Altnagelvin, Londonderry, and Princess Margaret, Swindon—are both large general hospitals. Superficially, they are quite different from each other; Altnagelvin is planned on a vertical scale and is dominated by a ten-storey ward block, whilst Swindon is generally on a horizontal scale, and, when completed, will have no buildings rising above five storeys. In the feature with which this article is most closely concerned —their lighting—the two hospitals have in common the general use of tungsten filament lamps, with certain exceptions at Swindon.

In its general arrangement, Altnagelvin comprises a central building of wards and treatment areas around which the ancillary buildings—kitchen block, workshops, boiler house, laundry, nurses' home and staff dwellings—are sited, but at some distance, thus isolating the hospital from noise, traffic, smells and similar disturbances. The hospital itself is planned in the form of a T, of which the leg (which runs approximately NW–SE) is the north wing of the building, devoted largely to treatment and surgery. The east wing of the building is the ten-storey ward block with the casualty department located on its ground floor. This is to be joined ultimately by a west wing which will bring the capacity of the hospital from its present 390 beds up to about 600.

At Swindon, the layout of the buildings is much more compact. The hospital building itself is approximately H-shaped in





PRINCESS MARGARET:

From top to bottom: main entrance hall, showing lay light and artificial lighting over entrance desk; day space in the temporary ward accommodation, depicting the clerestory lighting used in this area and the 'brandy glass' fittings which are widely used in the hospital; view of plaster room to show equipment used for the general lighting of 'functional' areas, and medical inspection fittings.

(Photos: *Architectural Review*, *Architects' Journal*, de Burgh Galwey)

plan, with the cross-bar forming a wide central corridor running NE to SW from the main entrance at the northern end. The site slopes towards the south, enabling a lower ground floor to be provided at the southern end of the building.

Flanking the entrance end of the main corridor are the single-storey casualty and out-patients' departments and administrative offices. On the same floor level, at the other end of the corridor, is the area at present being used temporarily as an accident ward of 39 beds, and the physiotherapy department. Below these buildings are situated the X-ray, the central sterile supply, and pathology and post-mortem departments. The X-ray department is connected by a corridor to the single-storey operating theatre block.

In the second stage of the Princess Margaret project, the theatre block is to be extended eastward to house two more theatres, and the ward block erected to the east of the present hospital building. Also to be provided is part of the nurses' training school and a service area, containing kitchen, laundry, boiler house, workshops, and general stores. In the final stage of the building, maternity, pediatric and geriatric units are to be built to the east of the main ward, bringing the number of beds to about 600.

As mentioned earlier, artificial lighting in both hospitals is almost wholly tungsten, using, in the main, glassware and metal as the light controlling elements. The architects in both cases were aiming to create a 'domestic' atmosphere, in contributing to which filament lighting would be much more familiar to patients; this attitude was generally supported by the hospital authorities associated with the planning. In general, levels of illumination in working areas (consulting rooms, treatment rooms, utility areas and the like) lie between 10 and 20 lm/ft² tending toward the upper end of that range.

Ward Lighting

In considering the ward lighting, an important distinction must be drawn between the two hospitals; in Altnagelvin the ward accommodation provided is both extensive and permanent, whereas in Princess Margaret the present ward accommodation is small and only temporary and its lighting moreover is not likely to be repeated in the permanent wards, whose construction is not sufficiently advanced for details of their lighting to have been determined. On the other hand, the wards in the two hospitals have in common the small size characteristic of modern hospital practice; the largest being of no more than six beds.

In wards at Altnagelvin, general lighting is provided from two cylindrical diffusing fittings made specially to the architects' design by Frederick Thomas & Co. They comprise 9 in. diameter open-ended cylinders of $\frac{1}{8}$ in. thick 040 opal 'Perspex',

16 in. long and housing a 150W lamp; provision is made to include a 25W emergency lamp if required. The fittings are suspended on the centre line of the room with the base of the cylinder 7 ft above floor level. Local lighting is provided by means of wall-mounted 'Anglepoise' fittings with 60W lamps, fixed to outlets 5 ft above floor level and positioned over the right-hand edge of each bed. These units are installed to serve the dual function of patient's reading lamp and medical inspection lamp. Night time lighting is provided from a box recessed into the window wall just above the skirting. It houses a 15W lamp, which is enclosed by a cover plate into which has been cut a hooded louvered slot.

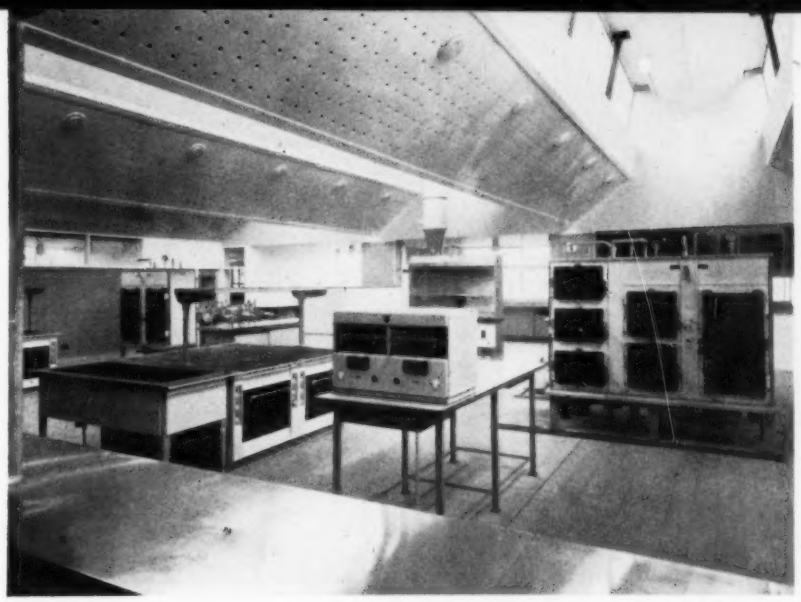
In the ancillary areas associated with each ward unit lighting is generally from GEC 'acorn' opal glass-ware, housing 150W lamps. In bathrooms, kitchens and examination rooms, totally enclosed versions are used; elsewhere, open-base types fitted with louvers. This type of fitting is also widely used throughout the hospital in medical departments.

In Princess Margaret, general-purpose lighting in the larger wards is provided from ceiling mounted metal fittings, housing two 75W lamps. These are of the Merchant Adventurers' 'drum' series, comprising an outer cylindrical case, 12 in. diameter and 5 in. deep, painted black outside and white inside and housing concentric white louvers. Two night-lighting units are also installed, comprising circular bulkhead fittings recessed into the walls below the two beds nearest the window. In the single wards, and in the staff rooms a Forrest type AIT fitting is employed, with a 100W lamp.

In the day space, an open area some 19 ft by 20 ft, use is made of fittings from Merchant Adventurers' 'brandy glass' series, fitted with a black-finished metal reflector and housing a 100W lamp. Considerable use is made of this fitting elsewhere in the hospital, notably for consulting rooms and similar areas. Elsewhere in the ward (and in the hospital generally) for other 'working areas'—kitchens, utility rooms, sluice rooms, treatment rooms and the like—SLR Electric's C.81 glass fittings, fitted with 60W lamps, are fitted, and for certain other areas, Hume Atkins' type HA fittings have been adopted.

Operating Theatres

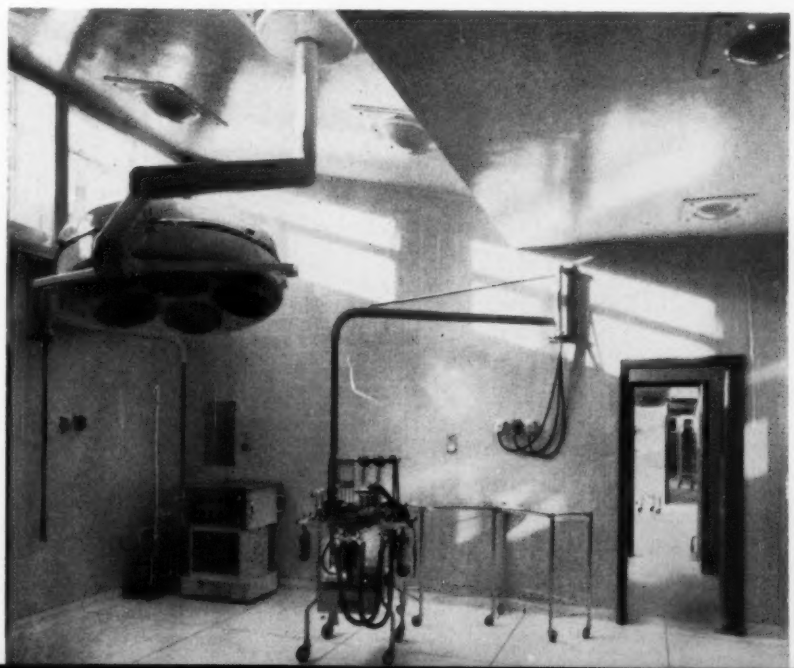
Of operating theatres, in both hospitals, there is a common feature in the use of German 'Hanalux' theatre lighting fittings. For major theatres, use is made of the 'Super Hanalux', incorporating seven lamps operating at 24V, a.c. or d.c., the only difference being in method of mounting. For minor and maternity theatres, Altnagelvin make use of a single-lamp 'Scialytic' fitting, whilst Princess Margaret have adopted a simpler version of the 'Hanalux' unit.



ALTNAGELVIN:

From top to bottom: use of bulkhead fittings fitted in the ceiling of a monitor roof; angle type wall mounted glass spheres for local lighting of wash basins; operating theatre, with the clerestory lighting which is a feature of this hospital, and the specially made recessed diffusing fittings.

(Photos: Sam Lambert, *Architects' Journal*)



PRINCESS MARGARET:

From top to bottom: temporary ward seen from nurses' station, showing drum fittings; casualty treatment area, lighted by fluorescent module fittings; operating theatre, with recessed diffusing filament fittings.

(Photos: *Architects' Journal*, de Burgh Galwey)

The structural design of the major theatres differs considerably between the two hospitals. In Altnagelvin, there are four such theatres, occupying, with their associated rooms, the entire top floor of the treatment wing. By suitable siting of the ventilation plant on the roof above, it has been possible to provide clerestory lighting to this area. A double corridor access system has also been provided, to separate staff and patients.

In the theatres, which are approximately 17 ft by 20 ft, general artificial lighting is provided by six recessed fittings specially made by Frederick Thomas to the architects' design, giving a level of illumination of some 30 lm/ft².

Each fitting comprises an $18\frac{5}{8}$ in. square box, $4\frac{5}{8}$ in. deep, recessed into the ceiling, provided with a polished aluminium reflector and housing four 100W lamps for general lighting and one 25W emergency lamp. The box is sealed by a 24 in. square hinged cover containing a 17 in. diameter diffusing visor of white flashed opal glass. Both visor and cover plate are bedded on gaskets to minimize the ingress of dust and other bacteria-harbouring agents. A similar fitting, but of smaller dimensions, and housing one 200W lamp and a 25W emergency lamp is used in minor theatres and delivery rooms.

The immediately obvious difference at Swindon in the operating theatres there is that they are housed in a single-storey building. Although two theatres have so far been built, only one is in use at present, but the two are arranged in plan as mirror images, with single corridor access.

General lighting in the theatre is also provided from recessed fittings, specially made for the purpose by the General Electric Co Ltd. They comprise circular boxes housing two lamps, of 100W or 150W, and enclosed by a flat diffusing glass visor secured by a gasketted ring plate.

The theatre is approximately 19 by 22 ft

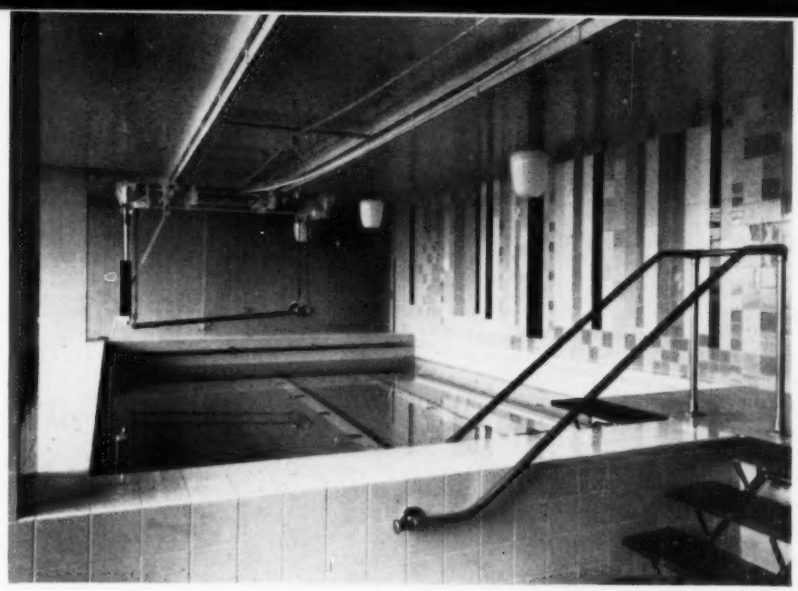
and eight fittings are arranged in diagonal lines symmetrically about the centre, at which the operating theatre fitting is sited, whilst another two are sited on the centre line parallel to the shorter wall. This lighting achieves a level of illumination on the floor of 43 lm/ft² at the centre of the theatre, falling to about 33 lm/ft² at 8 ft from the centre.

Fluorescent Lighting

In Princess Margaret, there is also the use of fluorescent lighting in the casualty, physiotherapy, and pathology departments. In the casualty department, this type of lighting is used in the treatment area, which incorporates the minor operating theatres. The area has been treated as a single entity by having an acoustic tile ceiling over its greater part, which has permitted the use of module fittings taken from the GEC's IE5 range. The two theatres have been excluded from this ceiling, although, in plan, they occupy the two corners at one end of the treatment area.

Fluorescent lighting in the physiotherapy department is installed in the gymnasium. It takes the form of continuous runs of tubes sited on each side of the wood slat ceiling and screened by diamond pattern louvres flush with the ceiling. In the same department certain of the corridors are lighted by inverted trough fittings, suspended transversely from the soffits of beams spanning the corridor at about 15 ft intervals. The other use of fluorescent lighting, in the main laboratories of the pathology department, makes use of conventional 'semi-decorative' suspended units fitted with reeded 'Perspex' diffusers.

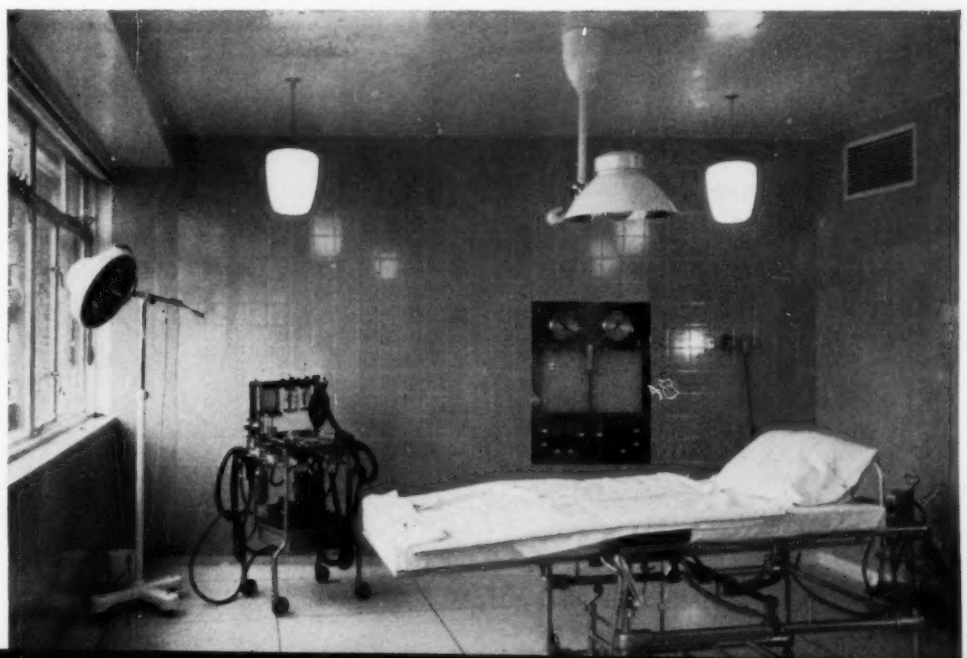
Acknowledgment is made with thanks to the architects and consulting engineers concerned with the two hospitals (and of which details are given on page 359) for assistance in the preparation of this article.



ALTNAGELVIN:

From top to bottom: hydrotherapy pool, with 'acorn' glass ware—the tiled mural is by Paul Feiler; typical corridor area illustrating type of square diffusing acrylic fitting used; maternity delivery room, illustrating fixed 'Scialytic' theatre fitting, and further use of 'acorn' glass ware.

(Photos: Sam Lambert, *Architects' Journal*)



HOSPITAL LIGHTING

Corridors and circulation areas

THE LIGHTING of circulation and ancillary areas of hospitals must do more than satisfy the functional requirements. Like the lighting of the wards themselves, it must help create an atmosphere conducive to the patient's recovery. With a growing understanding of the inter-relation of mental and physical sickness has come an appreciation of the psychological content of many complaints hitherto thought to be wholly physical in origin. As a corollary to this, it is now realized that the patient's physical surroundings can play a big role in his treatment.

This theory is demonstrated most clearly in the case of mental sickness. Consider the following description of a mental hospital built during the last century: 'One reaches the entrance by a long flight of stairs. The outside of the building looks like a Gothic castle. The hall is high, gloomy and so dimly lit that, in contrast to the outside, it seems dark. As the eye accommodates itself, one notices the gleaming walls which tower over one. . . . ' Or this account of a hospital in Saskatchewan: 'The patient arrives at a massive open porch which must be 20 ft high . . . [He climbs] two steep flights of stairs . . . traverses a grey marble corridor, which must be 13 ft wide and 75–100 ft long, flanked by doors. He then reaches a desk situated at a sort of internal crossroads. Beyond this desk . . . a flight of gleaming brass stairs rises and disappears upward into darkness. At any moment one expects to hear the pealing of celestial trumpets or demoniac laughter.'*

Clearly, it is a wonder that anyone is ever cured of anything in hospitals with such an atmosphere. One must remember, however, that the Victorians believed that only the weak-willed became sick and that comfortable conditions in hospital wards would simply encourage more people to succumb. This attitude persisted for a long time and is not unknown today. Certainly, it is only in the hospitals built since the end of the 1939–45 war that the belief that 'the physical environment—the atmosphere around the patient—is part of the process of care to which he is subjected'† has been thoroughly put into practice.

In an article on this subject in its July/August 1960 issue the journal *Interior Design and Contract Furnishing* listed some of the ways in which the decor of the Princess Margaret and Altnagelvin hospitals helps to give the patient an appropriate feeling of security and confidence. These included: 'the subdivision of wards into small units containing not more than six beds; low ceiling heights (as little as 8 ft in corridors at Londonderry); the avoidance of long, claustrophobic corridors; the use of matt, instead of glossy paint; the use of natural hardwood, instead of painted softwood, for door frames, skirtings, window sills and guard rails; gaily-patterned curtains at windows and for ward cubicles; furniture—in wards, day rooms and waiting areas—selected from makers' domestic ranges; chair coverings of woven fabrics instead of the

* Both descriptions come from a paper given by H. Osmond, Physician Superintendent, Weyburn Hospital, Weyburn, Sasketchewan, at a session on the 'Future role of the Hospital' at the 1960 Conference of the National Association for Mental Health.

† From a paper by Richard Llewellyn Davies, MA(CANTAB), FRIBA, at the same conference.

Reception hall at Swindon, lit by two rows of fittings with glass shades, supplemented by local lighting over the counter. Note also the use of modified Atlas 'kitchen light' fittings for direction signs.

Above, corridor in the new admission unit at St John's mental hospital, Stone, Aylesbury. (Architects, Gollins, Melvin, Ward & Partners.) Swing doors divide the corridor in half and daylight from rooflights creates a pattern on the floor. Artificial lighting is from ceiling-mounted tungsten fittings with semi-spherical opal-glass shades. Below, main hall at the Altnagelvin hospital, where lighting is solely from barrel-shaped opal-glass fittings fixed directly to the ceiling.
(Photos: Sam Lambert, *Architects' Journal*)

ubiquitous leathercloth; and sympathetically-chosen colour schemes.'

It is, perhaps, significant that lighting is not mentioned in this list. Certainly there is little about the lighting of these hospitals that would merit special attention. In the main hall at Altnagelvin, for example, the scheme comprises rows of barrel-shaped fittings of opal glass, while at the Princess Margaret hospital the artificial lighting of the reception hall comes mainly from inverted 'flower pots' of opal glass, fixed to the surface of the low ceiling. There is little attempt in either case to induce anything resembling a domestic atmosphere that might make the patients feel 'at home'.

The fault lies, perhaps, in a failure to separate the functional and (for want of a better word) psychological requirements. At Swindon, for example, the hall illustrated serves three purposes. There is a reception desk from which patients are directed to waiting areas in the consultants' wing; there is a seating area where patients' friends can wait; and there is a broad central passageway leading to other departments. Functional lighting is provided, appropriately, over the counter and there are illuminated directional signs. If a luminous beam had been recessed into the ceiling to assist in directing traffic along the central passageway (another, at right angles to it, could have directed patients towards the consultants' wing), this, together with spilt light from the counter and the signs, could have provided all the general lighting needed. Decorative lighting, perhaps in the form of domestic style standard lamps, could then have been used in the seating area to provide a more homely atmosphere.

At Londonderry, where the ceiling is higher, the fittings could have been grouped to form several large chandeliers. The variation in light intensity at floor level would have added interest to the scheme and created patterns of light and shade on the vast area of acoustic-tile ceiling. In general, it should be possible to light halls such as these mainly by spilt light from areas where strong lighting is required for functional needs, supplemented by decorative lighting from standard lamps or wall brackets, internally-illuminated showcases and spotlit poster displays or murals.

Turning to the corridors of the hospital, there is, because of the usual low ceiling height, much to be said for modular fittings recessed into the ceiling—a solution used in some, at least, of the corridors at Londonderry. The big problem with corridors, however, is to reduce their apparent length and nowhere has this been done more successfully than at Swindon where, in the physiotherapy department, waiting recesses at intervals along one side allow daylight to penetrate and, when the sun is shining, to create a pattern of light and shade on the corridor floor. Artificial lighting is from inverted metal troughs suspended below transverse beams, which break up the plane of the ceiling, while a further pattern is drawn on the wall facing the waiting recesses by daylight from clerestory windows.

A similar solution is demonstrated by the illustration of a corridor in the Bürgerhospital, Stuttgart, where borrowed light from the entrance hall (transmitted through horizontal bands of glass bricks) is interrupted by deep-section piers that cast useful shadows on the floor and ceiling. With supplementary lighting from wall brackets on alternate piers, no ceiling-mounted fittings were required.

Corridor treatment is particularly important in mental hospitals. There is something about a long corridor that has nightmare associations for the sanest of people. Those who are mentally unbalanced must be protected from such images, and in the planning of mental hospitals long corridors should, as far as possible, be avoided. It is important, too, that each part of such hospitals should be clearly differentiated. It is all too easy, in a strange hotel, to get out of the lift on the wrong floor and to feel bewildered when one's key does not open the lock of the door. Such bewilderment could be disastrous for a mental patient and positively different colour schemes should be used for all areas that are otherwise similar, with preferably different colours for each door in a length of corridor. Different lighting fittings, too, might be used in each corridor and in all other areas where confusion can arise.

Above, corridor in the Bürgerhospital, Stuttgart (architect, Jörg Herkommer), with borrowed light from main hall casting shadows of deep piers on floor and ceiling. Extra light comes from wall fittings on alternate piers. Below, corridor in the physiotherapy department of the Princess Margaret hospital, with daylight infiltrating from large window of waiting recess, and from clerestory windows, while artificial light is from fluorescent lamps in inverted troughs suspended below the transverse beams.

The Building Programme for Hospitals

NEW HOSPITALS PARTIALLY COMPLETED

Hospital	Type	Details of work already done and further planned
ENGLAND		
Balderton Hall, near Newark	Psychiatric	First phase including 252 beds completed at cost of over £1m., second phase of 156 beds being planned.
Good Hope, Sutton Coldfield		Six ward units totalling 162 beds at a cost of £100,000 in use for pre-convalescent and geriatric patients, to which supporting facilities are now being added.
Greaves Hall, Southport	Psychiatric	First phase including 220 beds completed at cost of about £900,000; second phase to bring the number of beds to 610 has started, further phase being planned.
Princess Margaret, Swindon		First phase comprising mainly out-patient and casualty services completed at cost of about £700,000. Building of the second stage to provide other ancillary services and ward block of more than 300 beds has started, cost about £1,380,000.
Hensingham, W. Cumberland		First phase, including geriatric, psychiatric and isolation units, providing a total number of 96 beds, now completed. A further phase is at advanced stage of planning to provide another 320 beds, including 60 for maternity patients.
WALES		
Llanfrechfa Grange, Newport	Psychiatric	Four villas with 200 beds and other services including occupational therapy department has been completed at cost of £430,000. Work is proceeding on the second phase to include 4 more villas with 200 beds.
Oakwood Park, near Conway	Psychiatric	First phase of adaptations to provide about 100 permanent beds completed at cost of about £625,000. Plans for further 200 beds are now being considered. Hospital will eventually provide for 450 patients.
Singleton Park, Swansea		The first phase including out-patients and X-ray departments at cost of about £400,000. Plans well advanced for second phase including 256 beds and operating theatres at estimated cost of over £1m.
West Wales, Glangwili		Replacement of war-time hutted hospital. First phase including 3-storey ward block with 96 beds as well as nurses' home completed at cost of £500,000. Work well under way on second phase which includes another ward block of 96 beds, out-patients and casualty departments, and laboratories, at estimated cost of £600,000. A further phase is being planned.

NEW HOSPITALS IN COURSE OF BUILDING

Hospital	Type	Details of work in progress
ENGLAND		
Cambridge	Teaching	This first phase includes an out-patients' department and 94 beds, comprising neurological and orthopaedic unit, estimated to cost nearly £1m.

Crawley		Out-patient, casualty and maternity departments estimated to cost over £300,000.
Harlow		First phase includes operating theatres, out-patient, casualty and radiology departments at an estimated cost of about £450,000. Subsequent stages will provide 208 acute beds and 58 maternity beds, pathology and physiotherapy departments.
Huddersfield		First phase to cost nearly £2m.
Peterborough Memorial		First phase, including staff accommodation, boiler house block, out-patients' and casualty departments to cost approximately £1m.
Royal Marsden Hospital, The Downs, Sutton	Branch of Royal Marsden Teaching Hospital	Being developed as a medical nuclear physics centre, including 86 beds for cancer patients in the first phase. The building and engineering work of this first phase is estimated to cost about £780,000.
Sheffield	Teaching	First phase, including out-patients' department, at estimated cost of £500,000.
Welwyn-Hatfield		Hospital of 330 beds at estimated cost of over £2m. A psychiatric unit is also being planned.

NEW HOSPITALS BEING PLANNED

The following are the new hospitals among over 180 major schemes so far selected by the Minister of Health in addition to the works carried out within the normal allocations to Hospital Boards; the actual starting date for building will depend on the time needed to complete planning and the capital resources then available.

Hospital Authority	
TEACHING	
Cardiff	Result of competition for design of this new teaching centre was announced in May. The centre will include hospital of 650 beds, medical and dental schools.
Charing Cross	New hospital at Fulham.
Royal Free	New hospital of some 800 beds at Hampstead.
St. Mary's Maternity, Manchester	First phase of some 50 beds.
St. Thomas's, London	The first stage of rebuilding will include ward block of approximately 200 beds, operating theatres, boiler house and a residential staff block. The cost will be in the region of £2¼m.
United Birmingham Hospitals	New Maternity Hospital to replace present one due to be evacuated when new inner ring road is started. Site may be in vicinity of Queen Elizabeth's Hospital.
United Liverpool Hospitals	Planning of first phase of new Teaching Hospital which will ultimately provide modern and more closely knit group than present Teaching Hospital comprises.
OTHER THAN TEACHING	
Boston	Competition in progress for design of new hospital which will comprise some 474 beds. Last date for submission of designs (first stage of competition) 30th September.
Coventry	A new hospital including maternity unit which will be started first.
Leeds R.H.B.*	New acute hospital for Hull.
Liverpool	New hospital at Fazakerley.
Psychiatric Hospital, Northamptonshire	New psychiatric hospital is needed for the northern part of the Oxford Region. The site and scope have not yet been settled.
North Tees-side	New hospital at Stockton-on-Tees. First phase to cost approximately £1m.
North West Met. R.H.B.	New building to rehouse Tavistock clinic. The N.W. Met. R.H.B. has tentatively proposed a site at Hampstead but this is not yet settled.
Queen Mary's, Sidcup*	New hospital to replace the existing hutted hospital.
Slough	A new hospital of 300 beds.
South Manchester	First phase of new hospital of about 400 beds, including maternity unit of 80 beds, to be sited at Baguley. Estimated cost is about £2½m. for whole hospital.
Truro	Detailed planning of the first phase to comprise 180 beds is nearing completion. The content of a second phase is under discussion.
Wembley	First phase of new hospital at Northwick Park.

* Regarded as new hospitals because proposed development of existing resources amounts virtually to entire rebuilding.

NEW DENTAL HOSPITALS

Birmingham	A new hospital to be built adjoining the Birmingham Hospital, which will be one of the Birmingham Teaching Hospitals. It will have an intake of 80 students a year.
Cardiff	A new dental teaching hospital to be built on part of the new medical centre is being planned.
Liverpool	A new dental teaching hospital is being planned.
Charles Clifford, Sheffield	Completed in 1953, at a cost of £200,000. Has an intake of 40 students per year and is one of the Sheffield Teaching Hospitals.
Kings College	To be built on a site adjoining the Teaching Hospital.
London Hospital	To be built on a site adjoining the Teaching Hospital.
University College Hospital, London	To be built adjoining this Teaching Hospital at an estimated cost of approximately £400,000. It will have an intake of 50 students a year.

Two Hospitals Compared (Continued from page 355)

	ALTNAGELVIN	PRINCESS MARGARET
Architects	Yorke, Rosenberg and Mardall	Powell and Moya
Consultant engineers	Oscar Faber and Partners Clarke, Nicholls and Marcell	J. Roger Preston and Partners Ove Arup and Partners
General contractors	Robert Colhoun Ltd Stewart and Partners Ltd	W. E. Chivers and Sons Ltd
Electrical contractor	B. French Ltd	Wm. Steward and Co Ltd
Theatre lighting	Sierex Ltd Technical Lights and Equipment Ltd	Sierex Ltd
General lighting	C. M. Churchouse Ltd Crompton Parkinson Ltd Courtney Pope (Electrical) Ltd Frederick Thomas and Co Ltd General Electric Co Ltd Holophane Ltd Merchant Adventurers Ltd	A.E.I. Lamp and Lighting Co Ltd Atlas Lighting Ltd Benjamin Electric Ltd Frederick Thomas and Co Ltd General Electric Co Ltd George Forrest and Son Ltd Hume, Atkins and Co Ltd Major Equipment Co Ltd Merchant Adventurers Ltd Simplex Electric Co Ltd S.L.R. Electric Ltd Troughton and Young (Lighting) Ltd

Design of Filament Lamps

— the need for compromise

By F. J. G. CLACK MA

The filament lamp in one form or another is used in a wide variety of applications. The importance which the lamp manufacturer must give to any particular lamp characteristic is determined by the use to which the lamp is to be put. This is frequently a matter of compromise as is discussed in this article.

THE VARIOUS CHARACTERISTICS OF ELECTRIC LAMPS, such as life, efficiency and colour, are to some extent interdependent and the lamp designer constantly has to compromise in order to give maximum satisfaction to users. The relative importance of the various interdependent characteristics has to be assessed in relation to each application and it is of some interest to note how and why the design of lamps for various purposes is influenced by the nature of those purposes.

Technical compromises are not the only ones which have to be made in practice, for if a lampmaker offered a precisely 'tailor made' lamp for every application his range of types would be enormous and the cost of each lamp would consequently be very high. By grouping applications with similar requirements and compromising on operating characteristics the number of types a lampmaker has to make, stock and sell is considerably reduced. Although this means departing in some cases from optimum designs, the user reaps the benefit of lower prices and the better quality which stems from mass production methods in lampmaking.

Life and efficiency

Efficiency of light production in filament lamps increases with filament temperature but higher temperatures reduce the filament life by increasing tungsten evaporation. Life is determined however not by the average filament temperature but by the temperature and rate of evaporation at the hottest part, and uniformity of filament temperature is the aim of every maker of filament lamps. If the filament is too thin at one point there will be a hot spot leading to early failure and any part which is too thick will be too cool and will lower the efficiency. In gasfilled lamps with coiled filaments the uniformity of coiling pitch is also critical for if two turns are too close there will again be a hot spot leading to early failure and turns which are too far apart will be unduly cooled by convection so that again efficiency will be lowered. For a given quality of lamp there is a compromise between life and efficiency, which is the subject only of commercial decision; it is, however, all too easy for a manufacturer to lose control of quality and produce lamps which are not only poor as regards both life and efficiency but are also very variable as between one lamp and another.

Fig. 1 shows typical 'design curves' of the relationship between life and efficiency for two makes of lamp, one of good quality and the other of not-so-good quality. The boxes drawn round the objectives embrace the variations between individual lamps produced and indicate the degree of 'quality control' exercised by the manufacturer.

Assuming good quality, the commercial decision regarding the life and efficiency compromise rests on the use to which the lamps are to be put, and the history of the development of general lighting service lamps is the history of a constant struggle to achieve greater efficiency without sacrificing life. It is a known fact that light is produced most cheaply when the electricity a gasfilled lamp consumes during its life costs about five times as much as the lamp itself and for many years this has indicated an optimum life for GLS lamps of about 1,000 hours. Lamps designed for infra-red heating, however, need not produce light, so filament temperature is lowered a little to give a 5,000 hour life. Going in the other direction, lamps for photographic studio lighting are designed to work at a higher temperature and to have a higher efficiency than GLS lamps because in their application a lot of light is needed for comparatively short periods; that the light then has a higher content of blue and green radiation, as it does with higher filament temperatures, is an advantage because black and white emulsions are more sensitive to the shorter wavelengths, and 'colour' films prefer a better balanced spectral distribution than is given by normal GLS lamps. For colour photography special ranges of lamps operating with a colour temperature* of 3,200° K are available. The fact that photographic lamps have a life of only a few hours is but a small price to pay for short exposures and good colour balance.

Table 1

Approximate changes in the performance of GLS type filament lamps due to the permitted voltage variation of ± 6 per cent

Voltage	−6%	+6%
Life	+100%	−50%
Light output (lm)	−11%	+20%
Efficiency (lm/W)	−9%	+10%
Watts	−7%	+9%
Amps	−3%	+2%
Ohms	−2½%	+2%

With projector lamps for the showing of slides, high filament brightness is all important to the achievement of adequate screen illumination and to get it a sacrifice of life is well worthwhile. Most projector lamps for such applications have lives of 25, 50 or 100 hours.

Apart from considerations of lamp design, the compromise between life and efficiency is affected by supply voltage variations; Table 1 shows the effects of the ± 6 per cent voltage variation within which supply authorities usually work.

Efficiency, wattage and voltage rating

With gasfilled filament lamps of a given voltage rating the higher the wattage, or for a given wattage, the lower the voltage rating, the thicker will be the filament wire. (In very simple terms this means that one way to get a 200W lamp would be to connect two 100W filaments in parallel, thus achieving the equivalent of a filament having the same length but twice the cross-sectional area; or to get a 100V 100W lamp one could take half the filament of a 200V 200W lamp.)

* Colour temperature denotes a colour not a temperature and the fact that colour temperature and filament temperature correspond to within a few degrees for incandescent filament lamps is merely a characteristic of the element tungsten which happens to radiate in a similar manner to a full radiator (a 'black body') so far as visible wavelengths are concerned. The definition of the colour temperature of a light source given in BS 233 is as follows: 'The temperature of a full radiator which would emit radiation of substantially the same spectral distribution in the visible region as the radiation from the light source and which would have the same colour.'

Increase of filament wire thickness leads to increased efficiency for two reasons. The first arises from the fact that the thickness of the 'Langmuir layer', the effective thickness of the layer of gas which clings to the surface of the wire, is substantially independent of wire thickness and that with thicker wires the effective surface from which heat can be removed by convection is therefore proportionately less in relationship to the surface area of the wire itself. This results in reduced convection losses and enables a given wattage to maintain a larger volume of tungsten at a given temperature than would be the case if the filament were thinner. The second reason arises from the fact that the surface area of a wire is proportional to the radius whereas the volume is proportional to the square of the radius. The amount of tungsten which evaporates in a given time depends upon the surface area and the temperature, whereas life depends on this and also upon the total volume of tungsten which is there to be evaporated. (Not that all the tungsten will have evaporated by the time failure occurs, for just as a chain will break at its weakest link, so will a filament break at its weakest point and there must, of course, be such a point even in the most carefully manufactured filament.) This means that for a given life a thicker filament may be operated at a slightly higher temperature and therefore with greater luminous efficiency. For these two reasons average efficiencies through life of about 8·1 lm/W apply for a 240V 40W lamp, about 18·3 lm/W for a 240V 1,500W lamp and about 11·2 lm/W for a 110V 40W lamp.

Table 2

Showing the variety of life efficiency compromise in lamp design

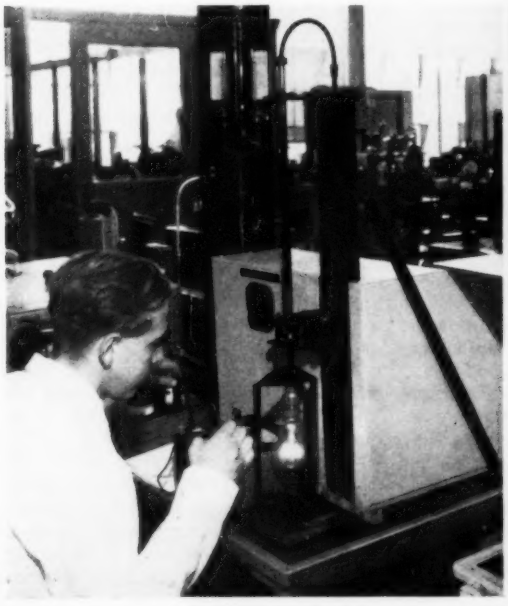
Type	Life (hrs)	Approx. filament temperature (°K)*	Efficiency (lm/W)
HV 25W GLS (vacuum)	1,000	2,400	8·0
HV 100W GLS	1,000	2,700	11·6
LV 100W GLS	1,000	2,750	14·0
HV 1,000W GLS	1,000	2,900	17·3
HV 100W A1 projector	50	2,750	15
HV 1,000W A1 projector	50	2,900	24·5
LV 1,000W A1 projector	50	3,050	26·0
HV 275W Photoflood	2	3,250	29·0
HV 150W Photographic enlarger	100	2,850	15·0
HV 1,000W Infra-red (quartz-tubular)	5,000	2,450	8·0
4V 1 amp Krypton miners handlamp	250	2,750	12·5

HV = 200–250 volts and LV = 100–130 volts.
* Not colour temperature.

With vacuum lamps only the second reason given above concerning the relationship of surface area to volume applies and an average efficiency throughout life of about 7·5 lm/W applies for the 240V 15W lamp and about 8·9 lm/W for the 100V 15W lamp. Coiled coil lamps which are available in the 40, 60, 75 and 100W ratings achieve 10–20 per cent higher efficiencies than the corresponding single coil lamps by having more compact filaments so reducing still further the effective surface area from which heat can be removed by convection and thus enabling a given wattage to maintain a larger volume of tungsten at the required temperature.

It is interesting to note that in the United States where the standard supply voltage is 120, more light per watt is obtained than in this country where the standard voltage is 240. The increase is about 30 per cent with the 40W lamp, 15–20 per cent with the 100W and rather less with higher wattages. It is, however, very much a case of swings and roundabouts in the GLS field, for although a low voltage lamp is more efficient it takes a heavier current which means either using heavier and more costly supply cables or putting up with greater power losses due to the resistance

Left, shock testing during the development of a new design of rough service lamp. Progressive damage to the filament is studied by continuous observation of electrical characteristics.
Right, studying the effects of vibration on a vehicle bulb. Vibrations are produced by means of an electrical oscillator which permits control of both amplitude and frequency; observations are being made with the aid of a stroboscope and a cathode ray oscilloscope.



of the cables—in either case it is the customer who pays.

The benefits of even lower voltages are particularly desirable in the application of lamps to projection. Lamps for use in slide and film projectors call for maximum filament temperature and brightness which is achieved in practice by the adoption of low voltage ratings and by sacrificing life. Using a lamp of a low voltage rating requires the provision of a transformer and this, of course, increases the initial cost of the equipment; in the past this extra expenditure was thought to be unjustified and mains voltage lamps were widely used but the makers of slide and amateur cinematograph projectors now accept the fact that the customer is prepared to meet the extra initial expense of a low voltage transformer in order to reap the advantages of higher brightness and increased efficiency which go with the short thick filament of a low voltage lamp. The 12V 100W lamp with its filament wound on a rectangular mandrel and the 8V 50W lamp with integral spherical and elliptical reflectors, both developed primarily for 8 mm cinematograph projection, are of topical interest as also is the experimental 12V 100W quartz-iodine projector lamp which has been demonstrated on several occasions recently.

Robustness, efficiency and voltage rating

There are many situations in which lamps have to withstand mechanical shocks or vibrations of various kinds, and the necessary extra robustness is usually achieved either by using low voltage lamps with their short thick filaments, or by using high voltage (200–250V) lamps of special construction such as the widely used rough service lamps.

In some situations, e.g. on road vehicles and in aircraft, a low voltage supply is already available and on some trains although only a comparatively high voltage is directly available a number of low voltage lamps can be operated in series because the lamps are operated in groups rather than individually. In other situations, e.g. local lights mounted on machinery, where no low voltage supply is available, where series operation is impracticable because lamps operate individually, and where the provision of a transformer would be an unwarranted extravagance, robustness is achieved at the expense of some efficiency by using mains voltage rough service lamps.

Rough service lamps achieve robustness in five different ways:

(1) The tungsten used contains a small amount of thoria which makes the filament stronger than that of a normal GLS lamp. Thoria tungsten is not in general use, however, because it is much more difficult to work and the extra mechanical strength is not necessary in lamps for normal use.

(2) A smaller mandrel and a longer coiling pitch than usual are used to avoid the possibility of turns shorting when a shock is applied to the filament.

(3) Extra filament supports are provided.

(4) Filaments are designed to operate at a lower temperature than usual because the lower the temperature the less the tendency for the metal to flow and break under stress.

(5) Lower wattage (40 and 60W) Rough Service lamps are of vacuum construction in order to take advantage of the slightly greater wire diameter that can be used in a vacuum lamp.

Efficiency is sacrificed with the rough service lamp due to the lower filament temperature and to the extra heat loss by conduction through the increased number of filament supports. Initial efficiencies range from 7·5 to 10 lm/W.

A lamp, like any other article, has certain natural frequencies and is much more susceptible to vibrations of particular frequencies than to any other vibrations. The premature failure of filament lamps due to resonance effects is not, however, very common but when trouble does arise it is not always easy to overcome and usually calls for some redesigning of the lamp and/or protective measures to reduce the violence of the vibration to which the lamp is subjected. Generally speaking it is important to differentiate between intermittent shocks and vibrations to which the lamp does not resonate and vibrations to which the lamp does resonate.

Efficiency and glare

Glare is the unpleasant sensation we get when we see a bright light source. The severity of the sensation is primarily dependent on the brightness of the source compared with the brightness of the background against which it is seen and, generally speaking, a large source of low brightness causes less glare than a smaller brighter source of the same light output.

Source size is often increased and brightness decreased by putting the lamp inside a fitting or behind a panel of opal glass or diffusing plastic which scatters it in all directions so that the whole of the diffusing medium becomes the effective source. The diffusing medium can be incorporated in the glass of the lamp bulb itself or coated, internally or externally, on the surface of the bulb. In the most important variety of GLS lamp, the 'pearl' lamp, diffusion is achieved by etching the inside surface of the bulb thus obtaining a maximum brightness in the region of 100 candelas/in.² compared with the much higher brightnesses of 'clear' lamps which are in the region of 3,000 or 4,000 candelas/in.² This considerable reduction in glare is obtained with a sacrifice of only about 1 per cent of the light—and is perhaps the nearest we ever get in lighting to getting something for nothing.

Filament lamp 'design curves' illustrating differences in 'quality' and 'quality control'.

It is interesting to note that external etching would have two serious disadvantages in that light output would soon be reduced by the excessive amount of dust and dirt which would accumulate on the bulb, and even when new some 5 per cent of the light output would be lost due to internal reflections at the outer surface of the bulb. The difference in the amount of reflection at the inner and outer surfaces of the bulb with internal and external etching is due to the fact that total reflection occurs when light tries to pass out of glass into air with an angle of incidence greater than 41°. About 95 per cent of the incident light passes through the inner surface of the bulb, whether it be plain or etched, and what is reflected has another chance to get out when it reaches the opposite side of the bulb so that virtually all the light eventually gets into the glass of the bulb. If the inner surface is etched some of the scattered light will strike the outer surface at more than 41° and will then have to travel on through the glass suffering some absorption as it goes. If, however, the outer surface is etched, a much larger proportion of the light will strike the outer surface at more than 41° and much more of the light will have to suffer extra travel in the glass resulting in greater absorption.

An even greater degree of diffusion is obtained by coating the inside of a 'pearl' bulb with a fine powder of silica or the inside of a clear bulb with a fine powder of titania. The maximum brightness is then reduced to about 20 candelas/in.² but something between 5 and 10 per cent of the light from the filament is sacrificed in the process.

The sacrifice of light with the 'pearl' lamps is so small that one wonders why 'clear' lamps are still demanded in the normal household wattages of say, 15 to 200W; situations in which a 'clear' lamp is preferable to a 'pearl' are rare indeed. Even if the lamp is going to be completely enclosed in a diffusing fitting such as an opal sphere a 'pearl' lamp is to be preferred as it obviates the pattern of striations

which appears on the fitting when a clear lamp is used.

Source size and light distribution control

The narrowness of beam which a source and reflector can produce depends on the relative sizes of source and reflector. A large source can be regarded as a bundle of small sources which obviously cannot all be at the exact focus of a reflector at the same time. Any enlargement of the source beyond the hypothetical 'point source' results in spreading the beam and though the beam angle would remain more or less the same if source and reflector were scaled up together, large fittings are usually undesirable and when a narrow beam is required a compact filament is generally used. Many floodlighting fittings for example may be equipped with either GLS or Class B2 projector lamps; with GLS lamps they produce a broader beam than with B2 projector lamps because, although both types have the same principle dimensions the B2 lamps have a more concentrated or 'bunched' filament formation. Again, in display lighting, narrow beam spotlights often have low voltage lamps because such lamps have short, thick, compact filaments and can provide the required light distribution with a comparatively small reflector.

The dimensions of a filament may be small in one plane and large in another, as in the case of some theatre and aerodrome floodlighting lamps. Light redistribution may be considered in each plane separately and an asymmetric beam produced which is broad in the plane of the filament but narrow in the plane at right angles to the length of the filament.

Form and efficiency

We have seen earlier that the gasfilled lamp achieves its efficiency only by virtue of a compact filament form. If for aesthetic reasons a long filament of comparatively low wattage is desirable, as in the 'striplite', candle and architectural types, then gasfilling is impracticable and vacuum construction has to be used with consequent sacrifice of efficiency.

Colour and efficiency

Strongly coloured lamps are much used for decorative purposes and tinted lamps are sometimes used for general lighting when, for instance, an extra warm and cosy atmosphere is to be created. The required colour is obtained by the absorption of the unwanted colours produced by the filament, either by using coloured glass for the bulb, as with some of the red lamps used in domestic electric fires, or by coating the bulb internally or externally with some kind of pigment, coloured glaze or lacquer. The process inevitably results in reduced efficiency and a few typical values are given in Table 3. There may be quite appreciable differences between the products of various manufacturers, however, as several colouring processes are in use at the present time.

Table 3

Loss of light output with coloured filament lamps

Colour		Loss (%)
Pink tinted, for general lighting		20–25
Red	for decoration	90–95
Amber		40–50
Green		70–80
Blue		About 95

Conclusion

One or more of the relationships which have been discussed above are involved in the design of every lamp and it is no easy matter to weigh the various factors correctly. The use of standard type lamps whenever possible is advised—they cost less and give better service.

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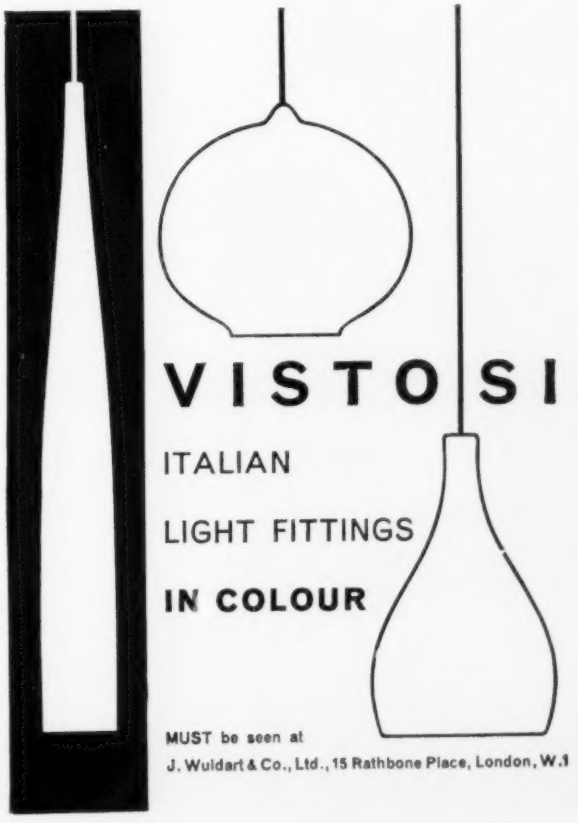


Lighting for Tile Production

By A. C. HOLDEN*, Dip. M.I.E.S.

Top picture shows the use of two 6W fluorescent lamps to provide local lighting for trimming tile edges (fettling), a process requiring dust extraction plant which obscures general lighting. Lower picture is of the glost warehouse in the old factory, with final inspection being carried out in an illumination of 60 lm/ft² provided by colour-matching (northlight) tubes. Daylight is excluded and neutral grey screens provided to keep viewing conditions constant.

A potteries' firm has recently relighted its factory, achieving a marked increase in the rejection of faulty products during the course of production and in final inspection. The results have led the firm to provide a still higher standard of lighting in their new factory, with further improvement in fault detection.

THOUGH IT IS WELL KNOWN that good lighting is a necessary part of efficient industry it has been difficult to find up-to-date statistical evidence and proof of its effect on production and quality of product. The evidence provided by the experience of George Woolliscroft and Son Ltd, of Stoke-on-Trent, is therefore of special interest.

This firm is one of the leading glazed and floor tile manufacturers in the country and takes a great deal of pride in the quality of their products. Recently they made an intensive study of production methods and called in the British Lighting Council for preliminary help with associated lighting problems.

To manufacture a first-class quality tile economicaly is not as simple as one might suppose. Whilst mechanical and handling processes are not exacting—clay grinding, mixing, pressing and trimming, various periods of drying and baking, and a final glazing—the inspection processes are particularly exacting, since they largely determine the tile quality.

A clay product during its various stages of manufacture may develop such structural or surface faults as cracks, chips and pinholes of vairying size and depth; its shape may become deformed in handling or stacking. It may also be slightly off-colour, a particularly difficult fault to determine, for a tile may look almost exactly the rght colour when matched against a standard tile and will only show to be obviously wrong when laid with a number of matching tiles during installation.

However carefully production is carried out, there will inevitably be some tiles which have faults in the early stages, and despite the extensive mechanization in these works, there is no mechanical means of detecting such faults. Yet it is essential in the interests of economy to reject faulty products at the earliest possible stage, to avoid the needless expense in allowing them to pass through subsequent processes, only to be scrapped in the end. Virtually every operative in the production line has therefore to be, in effect, an 'inspector', maintaining a watchful eye for defects in material whatever stage it may have reached. It will thus be apparent that this situation requires a high standard of production lighting to assist the operatives carrying out this secondary function.

* Regional Engineer, British Lighting Council.

Original Lighting Installation

In the original lighting installation, the early stages of manufacture were lighted to levels of 10 to 15 lm/ft² by means of tungsten filament lamps in various types of conical reflectors. This created poor visual conditions; consequently, a fairly high proportion of slight surface imperfections escaped detection until final inspection. Subsequent consideration of the processes concerned indicated that for adequate inspection at these early stages an illumination of at least 30 lm/ft² should be provided, the lighting to have a directional component to emphasize the surface irregularities by creating well-defined shadows.

Final inspection, which involves critical judging of colour as well as watching for surface faults, was originally carried out mainly under daylight from a northlight roof. It was found that the inspectors' colour judgments varied considerably with change of daylight conditions outside. After dark, tungsten lighting of about 20 lm/ft² was used, introducing further variation in colour of light and making conditions so difficult that on some winter evenings the department had to close down.

New Lighting

The first step in relighting the factory was to improve the lighting of the final inspection department to 60 lm/ft² by an installation of twin 80W colour-matching (northlight) tubes. This change resulted in an immediate increase in the number of tiles rejected by the department, as small facial imperfections could now be readily detected. This in turn led to consideration of the lighting for earlier stages, to try to prevent so much faulty material reaching final inspection. The pressing and early inspection stages were accordingly relighted to an average level of 35 lm/ft², which reduced by about three-quarters the number of faulty tiles reaching final inspection.

New Tile Factory

The firm was so pleased with these results that in their new factory at Etruria they have gone a step further and designed for a general level of illumination of some 60 lm/ft² overall. For the final inspection stage a level of 140 lm/ft² has been provided, using double rows of trough fittings each housing two 80W colour-matching (northlight) lamps and provided with diffusing screens beneath to avoid difficulties of specular reflection from the high surface gloss of glazed tiles. Daylight has been entirely excluded from this section and the structure and plant are painted light grey to give inspectors a neutral surround which will not interfere with their colour judgment. The proportion of faulty tiles reaching final inspection in the new factory is now lower than at the existing works, and it is rare indeed for one to get through.

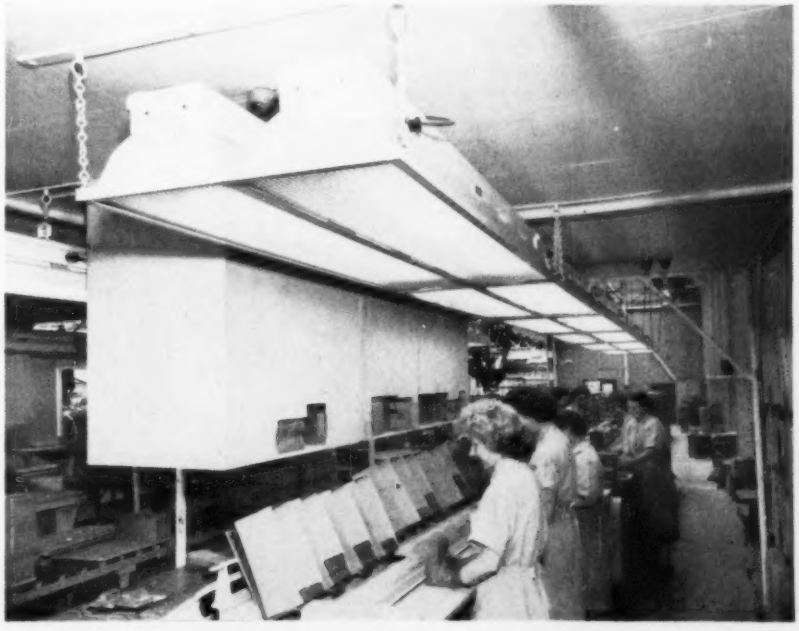
Lighting has always been a problem for Woolliscrofts, but at least they have recognized it as a problem and set out to find a solution. Having become satisfied that an illumination of 100 lm/ft² or more was necessary for rapid and accurate colour selection they spent the money and got the results they wanted. Besides producing high quality finished goods which enhance their reputation in the trade, they are saving money by being able to scrap most of the faulty material early in production; remaining off-colour tiles found at final inspection are not necessarily scrap, for they may now often be regraded into one of a number of groups according to shade and sold as 'seconds'.

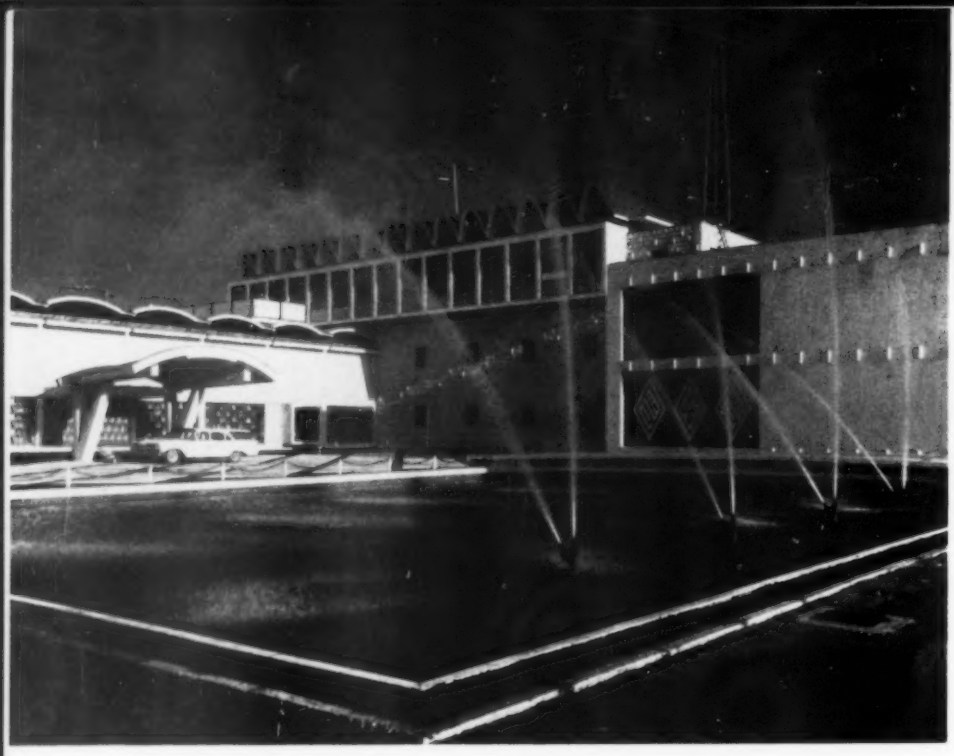
There is no doubt that even with the high quality lighting now installed, the problem of colour-matching to the required standard of accuracy is still difficult, since every tile has to be inspected individually; such methods of quality control as random sampling are out of the question. It can be said, however, that a great improvement has been effected, and that the company are well pleased with their end product—and with their lighting.

The scheme was planned, and equipment supplied, by the Benjamin Electric Ltd.

Truck loading prior to firing in the new factory. The angle type fittings achieve an illumination of some 60 lm/ft² on vertical tile surfaces.

Final inspection in the new factory. Double rows of twin 5-ft trough fittings housing 80W colour-matching (northlight) fluorescent lamps and enclosed by diffusing glass visors achieve an illumination of 140 lm/ft² in service.





Left, the view by daylight of the fountain pool and the forecourt with the main entrance porch on the left. The approach road enters the forecourt via a bridge over the far end of the pool; beneath the bridge are rows of coloured fluorescent tubes controlled by an automatic colour change system. Below, a view of the palace from the approach road, showing clearly the vaulted roofing.

Palace on the Persian Gulf

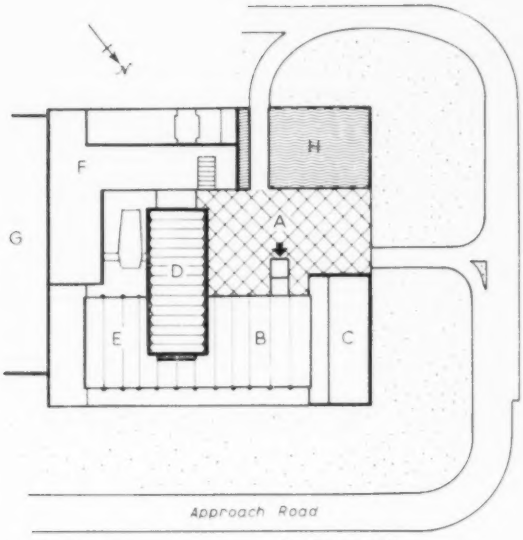
THE PALACE DESCRIBED IN THIS ARTICLE has been built on a man-made hill in the desert and is therefore a conspicuous feature both by day and by night. The lighting of the palace, particularly of the exterior with which this article is mainly concerned, presents a number of interesting and novel features. The main object of the lighting was to produce pleasing and, in some cases, dramatic effect; the illustrations show how well this has been achieved.

The main approach road to the palace, apart from being marked by an illuminated pylon, is lit by a continuous line of fluorescent fittings mounted only 9 in. above the road; the reflectors in these fittings were designed to keep the light on the road.

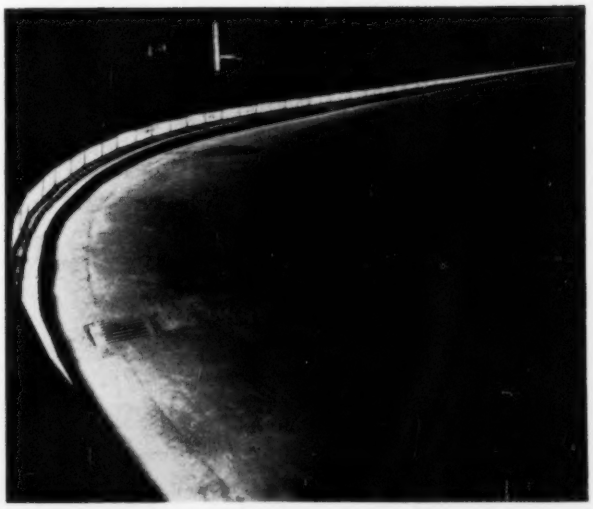
Before entering the forecourt the road crosses a fountain pool which is lit by coloured fluorescent lamps in special weatherproof fittings which are mounted in a recess under the bridge. Pink, blue and gold tubes are used, controlled by a three-colour change automatic electron dimmer board.

In the forecourt itself there are two types of fitting recessed flush with the paving stones. The first type, of which there are 85, houses a 60W tungsten lamp and has an aperture of only 2½ in.; one such fitting is located at the corners of each paving stone. The other type is used to illuminate the east and south walls of the forecourt; these house fluorescent tubes and are set in a zig-zag formation and covered by special glass covers to withstand the weight of vehicles.

A good deal of colour has been used both inside and outside the buildings and one of the tasks of the lighting designer was to bring out the colour by night. Concealed fluorescent tubes light the gold mosaic of the main entrance porch and the screen wall on either side of the porch which is clad with pale green ceramic tiles is floodlit by white fluorescent tubes

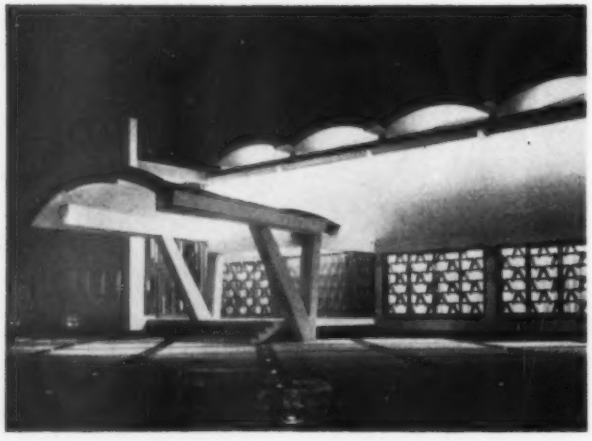


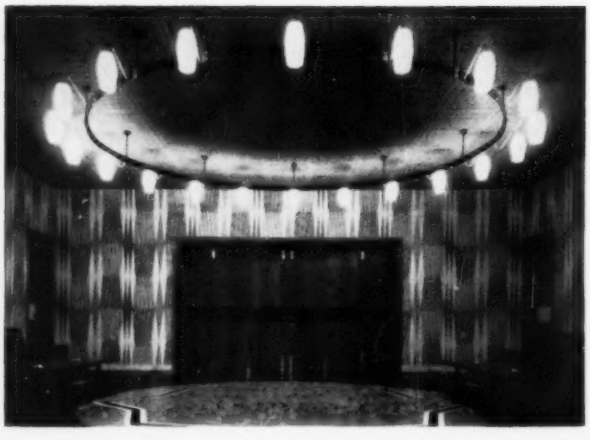
A - Forecourt
B - Entrance gallery & salon
C - Men guests
D - Sheikh's personal suite
E - Dining hall
F - Harem or family wings
G - Walled garden
H - Fountain pool

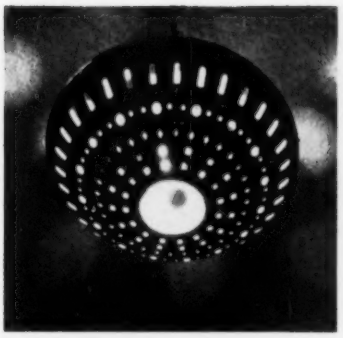


Top, the north-east façade at night, showing entrance gallery and salon at right and dining hall, left. Centre (right), the 30 ft pylon of light and guard-house on the approach road. The pylon is made from extruded brass sections and glazed with pin-head morocco glass. It is internally lit by twenty-one 4 ft fluorescent tubes, the control gear for which is housed away from the pylon in a specially constructed box designed to protect it from the heat of the sun. Right, low mounted fluorescent lighting on the approach road; the bottom of the fittings are 9 in. above the level of the road and they provide a continuous line 450 ft long. The reflector system is designed to direct the light output on to the road and not into the eyes of drivers. Immediately above is the plan of the palace buildings.

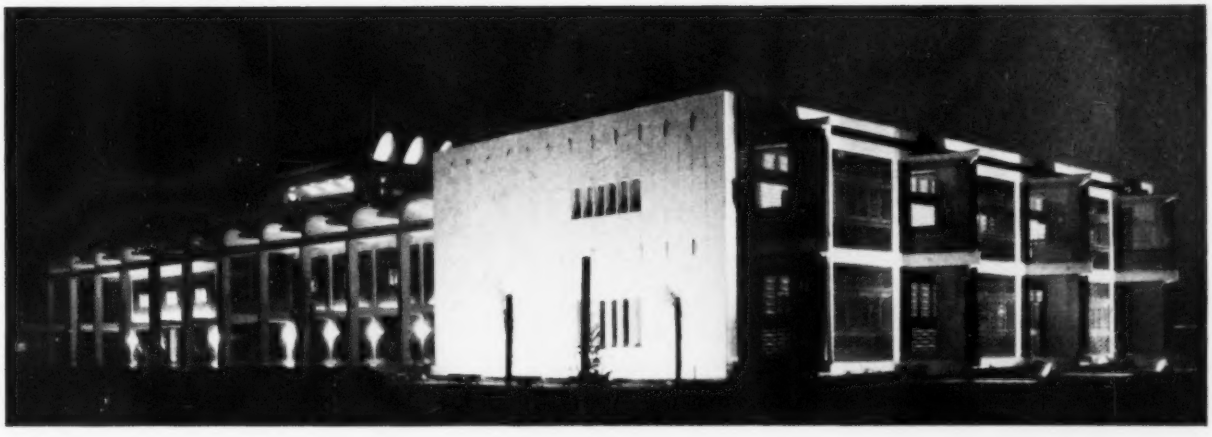
Above, the forecourt; note the small recessed tungsten filament lamp units at the corners of the paving stones and the recessed fluorescent fittings at the base of the east wall. Each of the vaults of the roof over the Sheikh's personal suite is lit by incandescent fittings to accentuate the gold and yellow mosaic with which they are clad. Below left, the main entrance porch and screen wall. The wall is clad in pale green ceramic tiles and is lit by white fluorescent tubes installed behind the marble facing panel at the top of the wall. The shallow vaulted roof seen above the wall is over the main salon; these vaults are finished with a blue mosaic and each is lit by a concealed filament fitting. Below right, the ante-room to the main dining room lit by George Forrest glass fittings on a 13 ft diameter black metal ring.







Left, a veranda in the family wing lit by ten specially made spun copper elliptical spheres perforated in various shapes. A close-up of one of the fittings, the maximum dimension of which is 18 in., is shown above. Below, the guest wing from the north. The screens on the right are made of blue anodized aluminium and are floodlit from one side only (the side away from the camera) by 300W tungsten floodlights.



installed behind the marble facing panel at the top of the wall. The Sheikh's personal quarters has a series of vaulted roofs open at each end, the inside edge of each vault being clad with gold or yellow mosaic floodlit from the inside by concealed tungsten lamp weather-proof fittings. The roof over the salon and dining hall block is made up of a series of shallower vaults finished in a blue mosaic and which are lit internally by concealed fluorescent tubes. A feature of the main façade of the guest wing is a series of blue anodized screens and white marble walls which are lit by 300W tungsten lamp floodlights.

The ceiling of the dining-room consists of suspended plaster-tiles which from below is completely covered by small nodules the tops of which have been sliced off leaving holes of about ½ in. diameter; through some thousands of such small holes the light from fluorescent tubes above the ceiling filters down. Forty 80W tubes are used in this ceiling and one of the problems was getting them there (and maintaining them thereafter) as the plaster tiles cannot be moved once fixed and they will not bear the weight of a man. The problem was solved by fitting up a series of double tracks of 'Rufflette' curtain track before the tiles were fixed and then using this as a 'railway' to haul wiring ducts, lamps and fittings into position.

Architects: Farmer & Dark
Architect in Charge: John Barton, ARIBA
Lighting Consultant: Richard W. Shaw, Atlas Lighting Ltd.

English Electric's new Office

DESPITE THE ARCHITECTURAL CONTROVERSY IT HAS AROUSED, the new headquarters office building of the English Electric Group employs some useful lighting techniques, notably the floodlighting of the main entrance façade, which to some observers will make the building's appearance by night more attractive than by day. From this entrance, the new building, known as English Electric House, extends 90 ft. along the Strand and 120 ft. along Aldwych, joining with the original Marconi House to enclose a central courtyard in which has been erected, in the centre of a floodlit fountain, the famous 'Angel' taken from the dome of the Gaiety Theatre which previously occupied the site.

Internally, an attractive lighting scheme is encountered in the entrance foyer. The ceiling is made up of a near-honeycomb pattern, in which the panels are painted pale blue and the relief outline gilded. In the centre of each panel is sited a semi-recessed diffusing filament fitting which creates an interesting visual pattern of light and shade mingling with the colour pattern of the ceiling.

Another area to receive special treatment is the Boardroom and Chairman's suite, which have been designed and furnished in a style influenced by Adam. General lighting is fluorescent, concealed behind generous cornices; this is supplemented by silver and crystal chandeliers and matching wall brackets with fabric shades. Walls are panelled in bleached Scandinavian pine to add an effect of spaciousness. Elsewhere on this floor, corridors are lit from cornices by cold cathode lamps, as are lift halls throughout the building, whilst offices have acoustic tile ceilings with semi-recessed 2-ft troffer fittings. The usual practice for other offices, however, is to employ ceiling mounted semi-decorative reeded diffuser fittings to provide illumination to between 30 and 35 lm ft^2.

Architects for the building were Adams, Holden and Pearson; consulting engineers, Oscar Faber and Partners; main contractors, Taylor Woodrow Construction Ltd; electrical sub-contractors, K.S. Construction Co Ltd. Lighting equipment was supplied by Troughton and Young (Lighting) Ltd; Crompton Parkinson Ltd; Courtney, Pope (Electrical) Ltd; The General Electric Co Ltd. Consultants and furnishers of the boardroom suite were Vaughan Needham Ltd, with Kenneth Lindy, Jospeh Hill and Partners as their designers.

From top to bottom on the left are seen: the Crompton luminous ceiling in the showroom, with unusual lozenge-shaped panels; indirect lighting in the boardroom, with Adam-style silver and crystal chandelier and matcing wall fittings; the decorative lighted ceiling in the main entrance hall. On right is the front of the new building, looking from the Strand.

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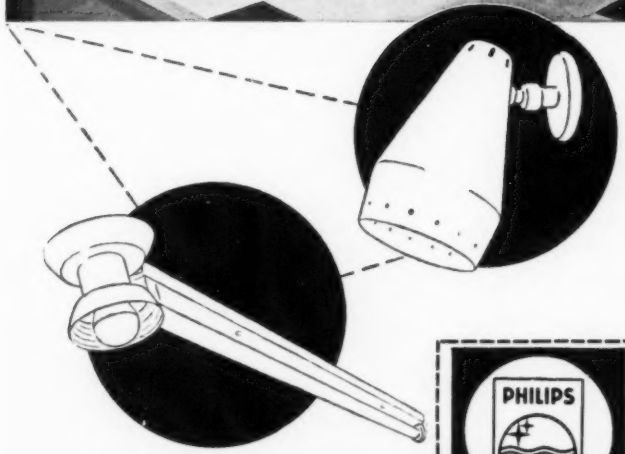

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Smee s 162

LIGHTING ABSTRACTS

OPTICS AND PHOTOMETRY

628.972

896. Calculation of direct flux in interiors by mechanical integration.

E. WITTIG, *Lichttechnik*, **12**, 493–496 (*Sept.* 1960). *In German.*

The three principal methods used for computing the flux reaching the working plane in a lighted interior are those of (i) Moon and Spencer, (ii) Croft, and (iii) Jones and Neidhart. The author has conducted an extended investigation of the respective accuracies attainable by these methods, taking for this purpose 14 typical light distribution curves and 9 room indexes ranging from $\frac{3}{4}$ to $7\frac{1}{2}$. The results given by the three methods were compared in each case with those calculated from first principles by the aid of a mechanical integrator and it was found that the errors were least for method (iii) and greatest for (i). J. W. T. W.

LAMPS AND FITTINGS

621.327.43

897. Circuit for running three fluorescent lamps from a single-phase supply.

P. CARRÉ, *Rev. Gén. Elect.* **60**, 434 (*Aug.* 1960). *In French.*

Describes a circuit developed from the 'twin tube' lag-lead circuit, in which a third lamp can be run from the same auxiliaries, the current in the third lamp being at a phase intermediate between those of the first two lamps, thus reducing flicker effects. The power factor of the complete arrangement is closely united. A line potential of 300V, however, is required, which it is suggested should be provided by a step-up transformer. J. M. W.

LIGHTING

898. Man and radiation. 550.35

R. SCHULZE, *Lichttechnik*, **12**, 443–448 (*August* 1960). *In German.*

An inaugural lecture at the meetings of the German IES. The various portions of the complete electromagnetic spectrum are taken seriatim and the probable effects they produce on the human organism are described. As far as radiation from the sun and outer space is concerned, the earth's atmosphere acts as a shield except for two regions, one embracing the beneficial wavelengths in the visible and near u.v., the other high-frequency radiation of wavelengths between about 3 cm. and 100 m. Much of the radiation we experience is of terrestrial or atmospheric origin; some is now produced artificially. J. W. T. W.

899. Adaptation on runway and turnpike. 621.843.36

D. E. SPENCER and S. C. PEEK, *Illum. Engng.*, **55**, 371–380 (*July* 1960).

The ratio of minimum perceptible contrast at a given adaptation level to the minimum perceptible contrast under optimum visual conditions (called the Delos) has been used as a measure of relative visibility in determining from theoretical considerations the effectiveness of different types of lighting on turnpikes (motorways) and aircraft runways under clear and foggy conditions. Low-mounted fluorescent luminaires are demonstrated to be more effective than high-mounted incandescent luminaires under foggy conditions on turnpikes. Recommendations are given for improving runway lighting, based on the calculated performances of low-mounted fluorescent luminaires and surface-mounted button-type lights. P. P.

612.843.3

900. A note on calculations of disability glare, veiling and contrast.

J. M. WALDRAM, *Trans. Illum. Eng. Soc.* (*London*), **25**, 131–134 (No. 3, 1960).

Disability glare has been shown by a number of workers to produce an effect which is equivalent to a veil over the scene. In order to follow the effect of this equivalent glare veil, object luminance is plotted linearly against background luminance. Even then the diagram is related to stimuli and not sensations. For the special case of a uniform background which is equal to the adaptation level, it is possible to use Hopkinson's (1941) apparent brightness data to give an indication of the conspicuousness of suprathreshold luminance differences and of the change in conspicuousness brought about by the disabling glare. P. P.

612.843.367

901. A note on the use of indices of glare discomfort for a code of lighting.

R. G. HOPKINSON, *Trans. Illum. Engl Soc.* (*London*), **25**, 135–138 (No. 3, 1960).

Present lighting codes usually prescribe limits for discomfort glare in terms of permissible luminaire luminances. This approach precludes the use of bright luminaires which might be quite acceptable in some lighting environments. The proposed method of controlling glare effects the limitation in terms of numerical values of glare index which must not be exceeded in particular locations. With this restriction, no limit is put on the luminaire luminance, and thus greater freedom in lighting design is achieved. The derivation of glare indices from the BRS (1950) glare formula is described and proposed limiting values of the glare index for a number of activities are offered. P. P.

902. A survey of drawing office lighting requirements. 628.977

J. B. COLLINS and F. J. LANGDON, *Trans. Illum. Eng. Soc.* (*London*), **25**, 87–106 (No. 3, 1960).

The lighting of ten different drawing offices has been studied by questionnaire and interview of the draughtsmen and by independent physical and subjective appraisals in order to formulate lighting requirements for drawing office work. Both natural and artificial lighting were studied, giving attention to such matters as desirable levels, the relative discomfort glare assessments of the draughtsmen and of experienced observers, preferences for general versus local lighting and for fluorescent versus incandescent lighting. A minimum of 5 per cent daylight factor for natural lighting and either 25–30 lm ft^2 of general artificial lighting supplemented by local lights or a well-designed installation of 50–100 lm ft^2 without local lights are advocated. P. P.

628.978

903. Application of regulations relating to the lighting of ships.

J. T. GRUNDY, *Trans. Illum. Eng. Soc.* (*London*), **25**, 115–127 (No. 3, 1960).

The various types of shipping are reviewed, and a summary is given of the statutory instruments, rules and regulations which have to be adhered to. The lighting requirements of various locations on a ship are then dealt with, giving attention to specialized requirements (viz. signal lamps and canal searchlights) and particular types of ship. Applications of hot and cold cathode lighting at sea are described and the problems of a.c. and d.c. operation, in some cases with limited voltage supply, are referred to. P. P.

904. Hours of darkness and comparative costing of artificial light. 628.92

C. H. ZIESENISS, *Lichttechnik*, **12**, 496–498 (*Sept.* 1960). *In German.*

The paper contains a series of diagrams giving the number of working hours during which artificial lighting is likely to be required. The different diagrams refer to a variety of schedules of working periods during a week. The number of hours in a year during which artificial lighting is required is an important factor in any comparison of the costs of different lighting systems. J. W. T. W.

905. The importance of esthetics in lighting. 628.972

A. H. FEDER, *Illum. Engng.*, **55**, 429-430 (*August* 1960).

Many people are unaware of the contribution which light makes to their everyday environments, merely acknowledging the presence of the luminaires producing the light. Yet it is the light itself which is largely responsible for the aesthetic effects created in an environment. P. P.

In the list of journals given with 'Lighting Abstracts' on p. 337 of last month's issue, the address of *Lux* should have been **33 Rue de Naples, Paris 8.**

IES Activities

AT ITS SESSIONAL MEETING on November 8, the Society was treated to what virtually amounted to a theatrical spectacle, in the presentation by Mr F. P. Bentham of his paper, 'Twenty-five years of stage lighting'. In his racy style he gave a one-man act in which the equipment his paper describes was used to provide appropriate histrionic effects and at the same time demonstrate its potentialities.

Requirements for theatre lighting are determined largely by London's west-end theatres, whose system of commercial management mitigates against providing the building complete with lighting equipment, and this is usually hired. The cost consciousness which this system creates, coupled with generally small stage areas, has resulted in development markedly different from the German theatre and, to a lesser extent, from the American theatre.

Tradition is a particularly significant factor in the theatre, producing a tendency to rely on early designs, which is strengthened by the existence of technical staff who are largely untrained, having picked up their techniques in the school of experience and are therefore loth to discard the tools they know intimately. One result of this is the continued provision for floodlighting battens and focusing-lamp spotlighting lanterns, which have limited versatility and low optical efficiency. Modern techniques call for greater use of directional lighting from projectors, which provide accurate control of the lighted area.

Modern equipment is being rationalized into eight basic types of lantern, of which the most significant are the profile and Fresnel spotlighting lanterns. The profile spot differs from the focusing-lamp spot in that the beam is the focus of an aperture rather than the focus of a filament. It gives a beam with a well-defined edge. Originally it was made in one size, of 1 kw, but recent lamp developments have enabled smaller versions to be produced. The Fresnel spot, giving a local flood of light with a 'soft' edge, is a comparative newcomer, but with the availability in large numbers of cheap lenses is likely to become widely used for local floodlighting. Its predecessor, the acting-area lantern, was designed to do roughly the same job as the Fresnel spot; it had a 26 deg. beam reflector and conical spill rings to give a narrow angle sharp cut-off beam.

Forthcoming Events

LONDON

December 13

Visual problems on motorways, by J. M. Waldram. Federation of British Industries, 21 Tothill Street, SW1, 6 p.m.

January 9

Modern aids to lighting design—Computer techniques, by H. R. Ruff, H. E. Bellchambers and G. K. Lambert. Federation of British Industries, 21 Tothill Street, SW1, 6 p.m.

CENTRES AND GROUPS

December 1

CARDIFF. Lamp progress and its application to modern lighting installations.

NOTTINGHAM. The eye and artificial lighting, by W. J. Wellwood Ferguson. Electricity Centre, Carrington Street, 6 p.m.

December 5

LEEDS. Members' night. Interesting lighting installations, by members of the centre. British Lighting Council, 24 Aire Street, Leeds 1, 6.15 p.m.

NEWCASTLE. Looking at lighting, by A. Wilcock. County Hotel, 6.30 p.m.

December 7

EDINBURGH. The lighting of outdoor industrial plant, by J. G. Holmes. YMCA Social Room, 14 South St Andrew Street, 6.15 p.m.

SWANSEA. Lighting and industry in the Soviet Union, by E. H. Norgrove. Demonstration theatre, South Wales Electricity Board, The Kingsway, 6 p.m.

December 8

GLASGOW. The lighting of outdoor industrial plant, by J. G. Holmes. Joint meeting with ASEE, British Lighting Council, 29 St Vincent Place, C1, 6.30 p.m.

MANCHESTER. Ship lighting, by J. T. Grundy and C. H. Vaughan. Demonstration Theatre, North Western Electricity Board, Town Hall Extension, Manchester 2, 6 p.m.

December 12

LEICESTER. Stage lighting, by E. E. Faraday, W. J. Furse Ltd, Nottingham.

December 13

LIVERPOOL. To be announced.

December 14

SHEFFIELD. Chance and vision, by D. L. Smare. Grand Hotel, 6.30 p.m.

December 16

BIRMINGHAM. Stage lighting, by F. P. Bentham. At Coventry, combined with visit to Belgrade Theatre.

January 2

BIRMINGHAM. Display of lighting fittings. Bennett Hall, YMCA, Snow Hill, 6 p.m.

January 4

SWANSEA. To be announced.

January 5

CARDIFF. Sports lighting, including the newly commissioned floodlighting of the Cardiff AFC ground, by W. G. Steward.

NOTTINGHAM. Light effect on dyes, by W. L. Lead. Electricity Centre, Carrington Street, 6 p.m.

MISCELLANY

Book Reviews

'Principles of Illumination' by H. Cotton, M.B.E., D.Sc., M.I.E.E. Published by Chapman and Hall, London, 1960. Pp. 526 with 2 colour plates, 39 photographs and 255 line drawings. Price 75s.

This book is intended primarily for the student preparing in this subject in Part III of the examinations of the Institution of Electrical Engineers or for the examinations of the City and Guilds of London Institute. Some chapters, however, particularly those on colour and illumination from linear and area sources, go beyond the requirements of these examinations and are intended for the practising engineering anxious to extend his knowledge of the subject. The author has drawn upon the work of many specialists in the various fields of the subject that are described and includes, as footnotes to the text, references to more detailed studies.

Beginning with a chapter on the concept of radiation, the reader is then introduced to reflection and refraction at plane and at curved surfaces, the spectrometer, the eye and vision, entities in the illumination system, and the illumination from point and from linear sources. Throughout these chapters are worked examples related to illuminating engineering practice.

A valuable chapter on colour includes sections on the three-colour sensation theory, the specification and measurement of colour, the CIE system, colour temperature, standard illuminants, colour mixtures, colour rendering and colour matching. Spectrophotometry and colorimetry occupy a great part of the chapter on photometry; the section on the measurement of intensity, flux, illumination and luminance seems rather sketchy by comparison, a section on the measurement of direct and diffuse transmission and reflection of materials used in lighting would have added to the value of this chapter.

Light source characteristics and operation are considered under the headings, temperature radiators, and discharge lamps —low and high pressures. The section on incandescent lamps is largely devoted to general service lamps and some data on other types and their applications would have been useful.

A chapter on illumination calculation includes a full description with data tables of the Harrison and Anderson lumen method of design and reference is made to one of the more recent suggestions for modifying and extending the method. More advanced methods of design which include aspects of the visual field, other than work plane illumination, are also given. Problems of daylighting, daylight factor and the indirect component are fully treated and

references to more advanced studies are given.

The last chapter deals with streetlighting problems, installation design and equipment. In some future edition of the book the description of the linear sodium lamp could perhaps be included in the chapter on low pressure discharge lamps instead of in the chapter on streetlighting.

The general layout and approach to the subject is good. It is well illustrated, the text is clear and easy to read, and the numerous examples a useful aid to understanding. That so many typographical errors, that are to be found, should have been allowed to pass unnoticed is surprising for a book at this price. A number of these errors will be easily recognized by the reader, but in some instances may mislead or confuse the student approaching the subject for the first time. Also there are several instances of incorrect acknowledgment in the captions to some of the figures.

H. E. B.

Personal

Troughton and Young (Lighting) Ltd announce that Mr A. B. READ, RDI, has rejoined them as design consultant. Mr Read will also continue his association with Carter and Co Ltd in a consulting capacity.

Mr A. B. SKEVINGTON, acting manager of Philips' Nottingham branch since September 1959, has been appointed branch manager from November 1. Mr Skevington joined the branch in 1949 as a lighting representative, was promoted to sales supervisor four years later and to area manager, Electrical Appliances Group, in 1957.

Philips Electrical Ltd also announce that their managing director, Mr G. HOFMAN, completed forty years' service with the firm on November 1, having started his career with them at Eindhoven and held his present position since 1949.

After fifty-two years in the electrical industry, Mr H. ETCHELLS of the AEI Lamp and Lighting Co Ltd has retired on the eve of his 66th birthday. Mr Etchells had been Preston area manager until January 1959, and since then had been acting in an advisory capacity to the company, having been with them (and previously with BTH), for thirty-seven years. He has been treasurer of the IES Manchester centre for thirteen years, secretary of the Manchester area EIBA for five years and a member of a number of other organizations in the industry.

Dr S. ENGLISH, F INST P, who was recently awarded honorary membership of the IES, relinquished the post of chairman of Holophane Ltd on September 30, although he is remaining on the board. He is succeeded as chairman by Mr H. G. CAMPBELL, TD, MA, who has been a director of the company for five years and is managing director of the Benjamin Electric Ltd, and is immediate past-president of the IES.

Industrial Notes

A REVISED VERSION of BS 495 has just been published as *Lamp caps and lampholders for double-capped tubular lamps*, having previously been entitled *Fittings for double-capped tubular lamps*. The revised document specifies in greater detail the requirements for lamp caps and holders for double-capped tubular lamps. Requirements for a combined pair of lampholders incorporated in a fitting suitable for double-capped tubular lamps have been included.

THE PHYSICAL SOCIETY EXHIBITION, now to be known as the Annual Exhibition of the Institute of Physics and the Physical Society, will be held at the Royal Horticultural Society's Old and New Halls, Westminster, SW1, from January 16 to 20, opening each day from 10 a.m. to 7 p.m., except January 17 (until 9 p.m.) and January 20 (until 1 p.m.). Tickets are available from the organizers at 47 Belgrave Square, SW1.

ESMA'S FOURTH DESIGN COMPETITION is for illuminated sign displays on a modern, architect-designed shop in the main shopping centre of a provincial town. The competition is to be judged by the Rt Hon Lord Mancroft, KBE, Sir Basil Spence, RA, RDI, PPRIBA, and Mr R. Nicholas, CBE, together with the chairman and vice-chairman of ESMA. Details can be obtained from the Electrical Sign Manufacturers' Association, 13 Bedford Row, London, WC1.

Overseas News

AN INTERESTING DEVELOPMENT of Sylvania Electric Products Inc is a new lighting unit for home cinematography which uses a high-temperature filament lamp operating on a halogen cycle, although the actual halogen is unspecified. The unit is a hand-held, single source fitting, with overall dimensions (without the mounting bracket) of 9¾ in. high, 4¾ in. wide and 2½ in. deep. It is stated to provide the same effective light as four photo-flood lamps.

WHAT IS CLAIMED TO BE the world's most efficient fluorescent lamp to be produced commercially is announced by the Westinghouse Electric International Co. It makes use of a new phosphor combination, to give 3,200 lm in its 40W size, as against a figure of 2,800 lm given by Westinghouse for ordinary 40W lamps. No indication is given if these values are initial light outputs or average through life; the highest efficiency British lamp of this rating gives 2,400 lm throughout its life. The new lamp is stated as producing 15 per cent more light than standard 40W cool-white lamps and 36 per cent more than daylight lamps. The new phosphors have a high green content.

FOR THOSE WHO LIKE TO KEEP ABREAST of current American ideas on lighting practice, Westinghouse also announce a new edition of their 'Lighting Handbook' which includes major revisions to sections on floodlighting, streetlighting and sign lighting, and also includes the latest recommendations of the American IES for commercial and industrial interiors.

Situations

Vacant

Atlas Lighting require keen TECHNICIANS age 18–35 years for interesting work on the development of ultra-modern lamps, in a laboratory situated in North London. Applicants should be of HNC standard or have 'A' level Physics. Previous experience in lamp making, glass working, high vacuum or lighting techniques would be advantageous. Write giving full details of experience and qualifications to: Atlas Lighting Ltd. (DEV LAB), Angel Factory Colony, Angel Road, Edmonton. N18.

Harris and Sheldon (Electrical) Ltd will be appointing two LIGHTING SALES ENGINEERS to cover the (1) Northern Home Counties, and (2) Southern Home Counties areas. These appointments are pensionable, offer good salary and prospects and a car will be provided. Applicants with sales' experience must be capable of handling complete projects at the highest level and should have experience in the areas concerned. Dip. MIES preferred. Write in confidence to the Sales Manager, Harris and Sheldon (Electrical) Ltd, 46 Great Marlborough Street, London, W1.

DRAUGHTSMAN OR DESIGNER required for lighting fittings design office in Uxbridge area. Experience in architectural metalwork or shopfitting would suit. Apply George Forrest and Son Ltd, Arundel Road, Uxbridge, Middlesex.

Lumenated Ceilings Ltd require SENIOR and JUNIOR LIGHTING ENGINEERS for their London office. The positions are permanent and pensionable with excellent salaries and prospects. Applicants should be keen to specialize in illuminated ceilings and will be expected to master all technical aspects associated with their operation and installation. The work is interesting and the senior engineer must be prepared to progress schemes to completion. Applications should be sent, giving full details, to: Chief Lighting Engineer, Lumenated Ceilings Ltd, Alliance House, 12 Caxton Street, London, SW1.

Postscript

A SERIES OF ARTICLES on 'Esthetics in Lighting', published in the August issue of the American *Illuminating Engineering*, is interesting as showing a trend of thought in the USA similar to one in our own and other European countries. The authors of all these articles stress the importance of those aspects of lighting—besides mere levels of illumination—which affect the appearance of ourselves, our fellow creatures and all the contents of our environments in a pleasing way. Gone is the erstwhile emphasis upon brightness uniformity, and in its place there is emphasis upon diversity and variety. This is more natural and human. One author recalls a paper by H. C. Weston in 1953 drawing attention to the tendency for conventional static artificial lighting to become boring on prolonged exposure to it, and he endorses the idea then expressed that more satisfaction might be got if the lighting is made 'suitably variable though constantly adequate'. Another of the authors, in a paper entitled 'Bland Environments', also deprecates too nearly uniform brightness as a lighting objective, and he points out that 'monotony and blandness must be counteracted by diversity'. He also gives a timely reminder that better visibility is sometimes got by relatively little light properly directed than by much light applied without suitable direction. A third author—Professor Gyorgy Kepes, a well-known designer—supports the plea for variety: 'without some variety,' he says, lighting 'becomes sterile and monotonous'. He adds, 'perhaps the intensity and/or colour of our lighting should be controlled automatically as is heat. We might, for example, use dimming equipment to continuously change the lighting between set limits . . .'. This is the sort of thing I meant by my October reference to 'jam' in lighting.

THE VALUE OF DELIVERIES of electric lamps by our lamp makers last year was something like £20,000,000 and, judging from the trend of deliveries up to August of the present year, the total for 1960 will be greater still. The fall in the value of monthly deliveries that always occurs during the period bounded by the two 'A' months—April through to August—was not so pronounced this year as it was in 1958 and 1959, and there was a 25 per cent increase in the value of lamps delivered during August this year as compared with August 1959. So, it is a bad summer that brings no one any good!

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WHILE ON THE SUBJECT of street lighting, a quaintly worded piece of relevant information was recently brought to my notice. It is an item from the accounts of the town of Totnes in Devonshire for the year 1639 and it reads: 'Paid Chr. Weston for warning the lights to be put into the streets from Alhalow to Candlemas.' This early reference to street lighting during the three months of the year—November, December and January—when the nights are longest, is a reminder that, in those days, it was the duty of every citizen—at any rate in London—to put a lighted candle or lantern over his door to provide such street lighting as there was. A good deal later there is evidence of the existence of a municipal public lighting 'engineer'. For example, in 1814 the Plymouth directory contains the name of Mr Ragland of French Lane, who is described as 'Surveyor of Lighting and Paving'. It was twenty-two years earlier and over the county border—in Cornwall—that Murdoch first utilized coal gas for lighting. But whether Mr Ragland had any gas-lit streets in his 'province' I don't know, though there was a number of them in London by 1814.

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'Lumeritas'

daylight for sale

4882

(How to win friends and influence customers with the nearest thing to daylight—MAZDA °KOLOR-RITE FLUORESCENT LAMPS)

Daylight not only helps skilled workers to do "close work", it also helps to sell what they're making. It sells anything from food to fabrics, from ice-cream to ideas. Only with daylight can you be absolutely sure that what you're displaying has a fighting chance of looking "the real thing".

But what happens at night, or indoors, when there's a shortage of daylight? Easy. Now you simply buy it—in the form of the new Mazda °Kolor-rite fluorescent lamps. These lamps really are the nearest thing to daylight. And because they have the effect of bringing outdoors indoors, they enable colours to look fresh and natural. What more could you want to make any presentation vividly attractive? Be sure you're getting Mazda °Kolor-rite fluorescent lamps. *Made in 5 ft. tubes with B.C. and Bi-pin caps. Also in 4 ft. tubes with Bi-pin caps.*

AEI
Lamp and Lighting Co. Ltd

Melton Road, Leicester

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°Kolor-rite

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Melton Road, Leicester

These capacitors measure up to the most stringent performance needs and reinforce Mr. Capacitor's claim to being your most reliable capacitor man.

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Type OR (—40 to + 60°C.)
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	Case Length	Cross Section	
8μF ± 10%	5½	2½ x 1$\frac{27}{32}$	OR 117384
10μF ± 10%	4½	3 x 2	OR 117336
13μF ± 10%	5$\frac{7}{8}$	3 x 2	OR 117337
15μF ± 10%	5½	3 x 2	OR 117338
18μF ± 10%	6$\frac{1}{16}$	3 x 2	OR 117339
20μF ± 10%	7½	3 x 2	OR 117340

Type AR (—5 to + 60°C.)
Welded Aluminium Cased, Elastomer Sealed

8μF ± 10%	4	2½ x 1$\frac{11}{16}$	AR 130043
10μF ± 10%	3	3 x 2	AR 130044
13μF ± 10%	3$\frac{13}{16}$	3 x 2	AR 130045
15μF ± 10%	4½	3 x 2	AR 130046
18μF ± 10%	5$\frac{7}{8}$	3 x 2	AR 130047
20μF ± 10%	5½	3 x 2	AR 130048
25μF ± 10%	6½	3 x 2	AR 130049

Type HB (—25 to + 60°C.)
Aluminium Cased, Elastomer Sealed

8μF ± 10%	2$\frac{15}{16}$	2$\frac{13}{16}$ x 1$\frac{7}{8}$	HB 117383
10μF ± 10%	3½	3 x 2	HB 117330
13μF ± 10%	3$\frac{13}{16}$	3 x 2	HB 117331
15μF ± 10%	4½	3 x 2	HB 117332
18μF ± 10%	4$\frac{13}{16}$	3 x 2	HB 117333
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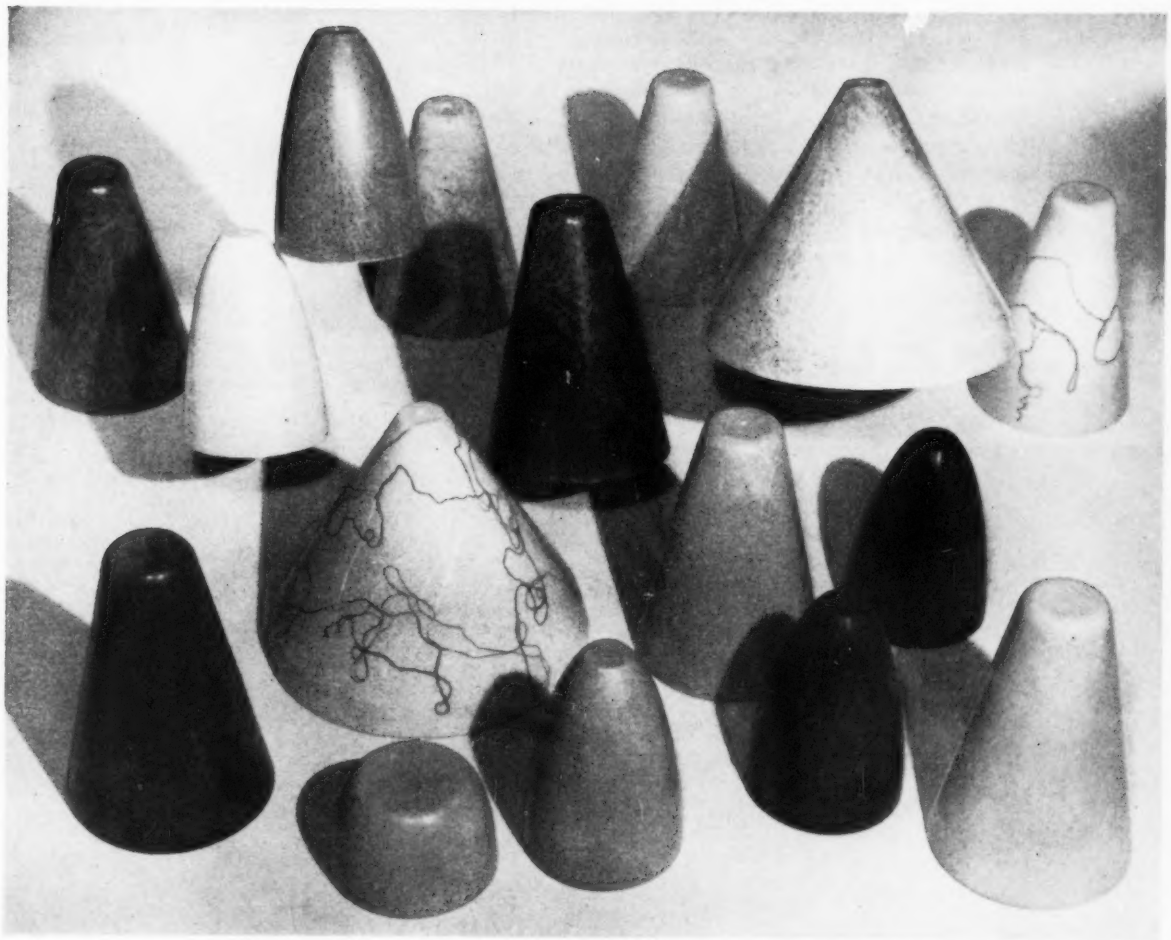

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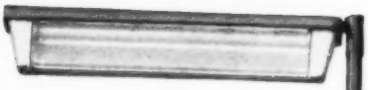

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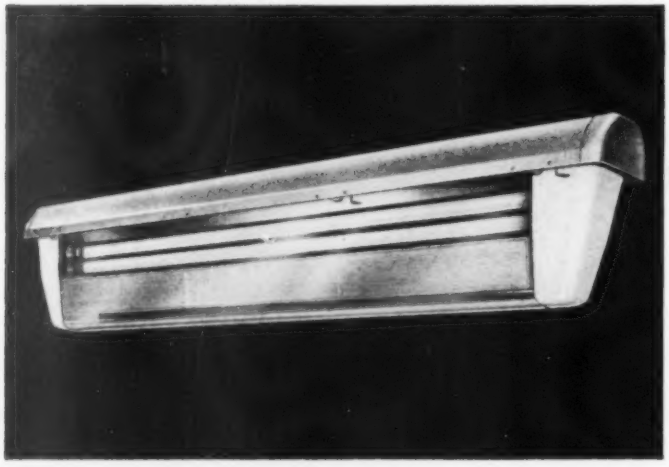
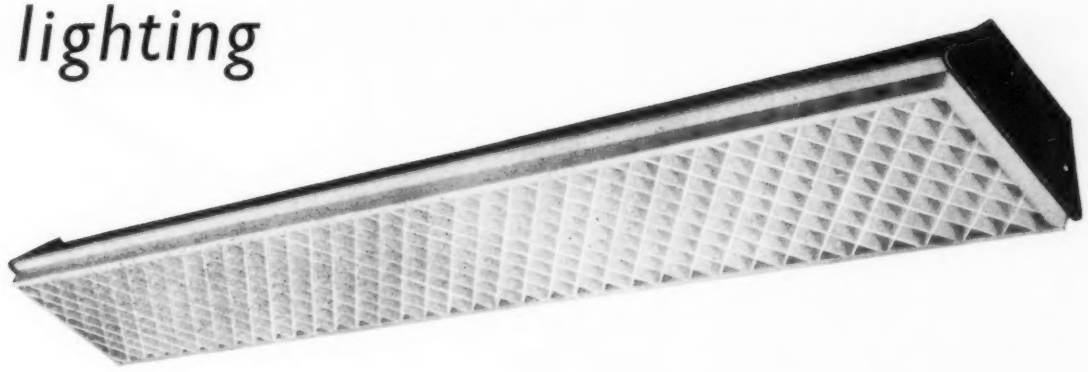


G.E.C.
LIGHTING DIVISION

The General Electric Co. Ltd., Magnet House, Kingsway, London, WC2

plastic components in lighting



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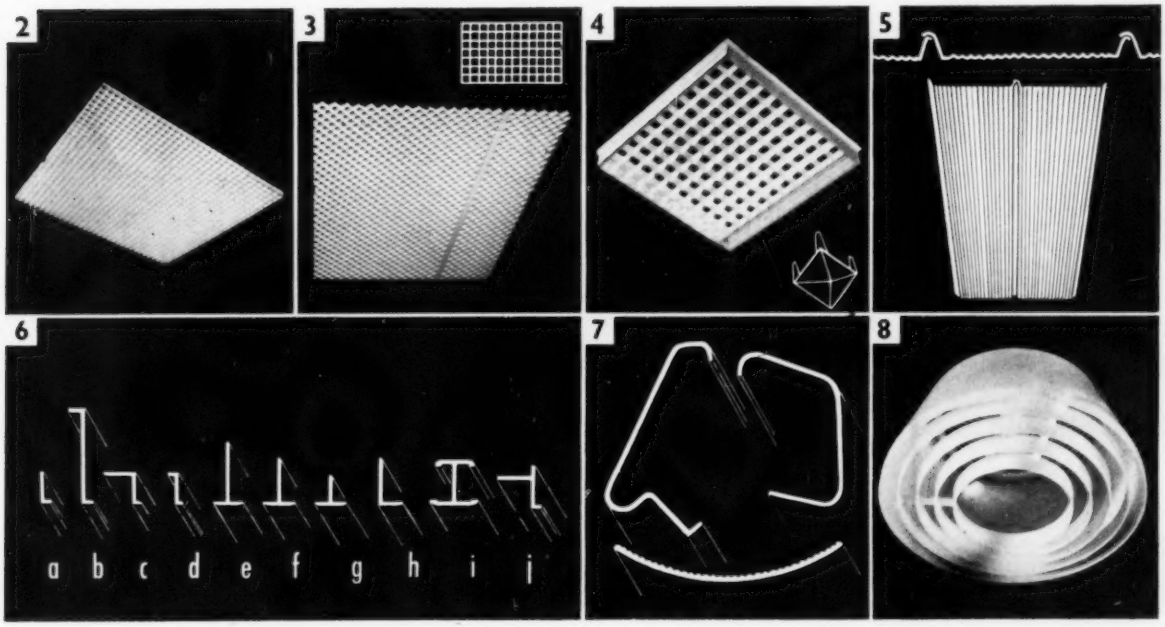
6 Plastic supporting sections.

7 Typical sections of plastic extruded diffusers, as supplied to lighting fitting manufacturers.

8 Moulded plastic shade and louvre as produced to the design of Messrs Hume Atkins & Co. Ltd. (Registered Design No. 880153).



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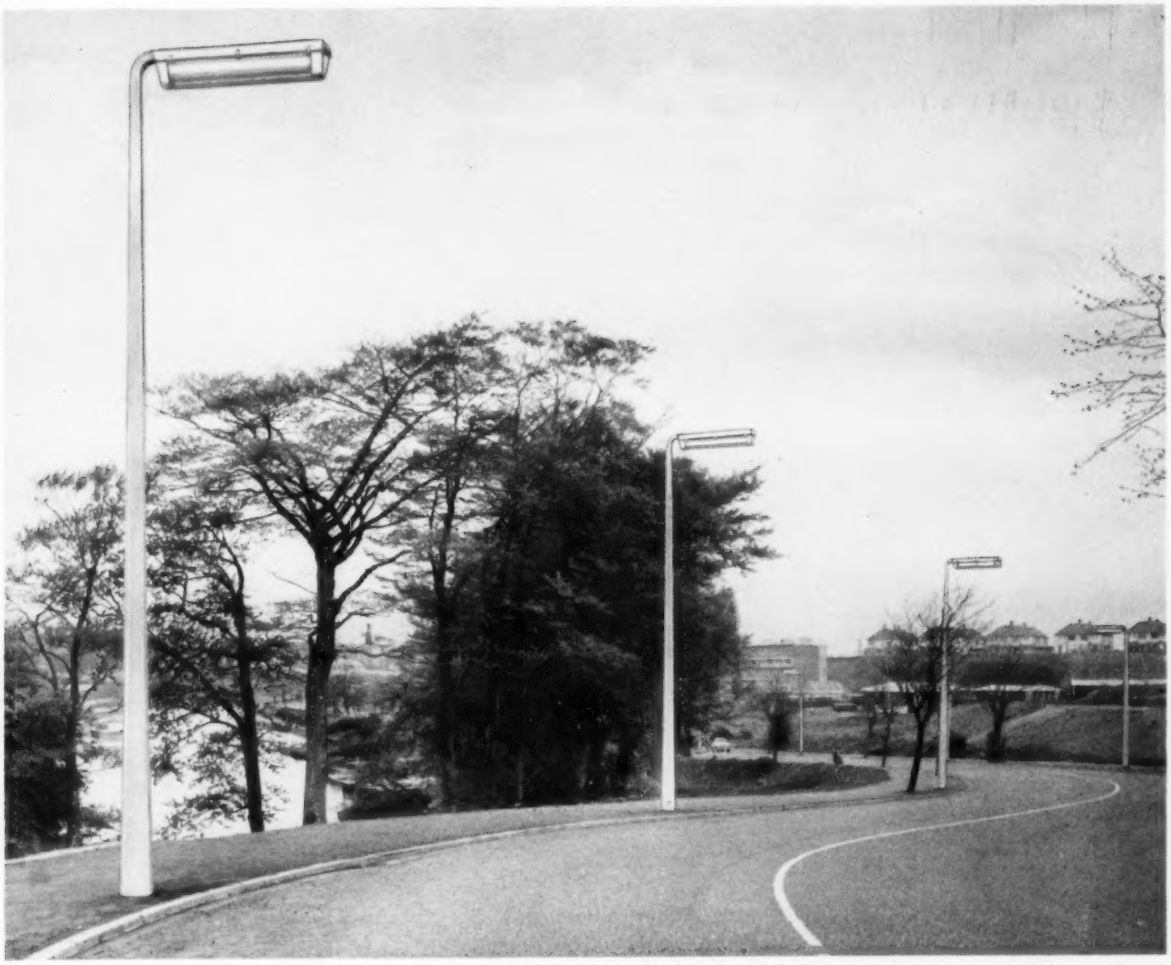
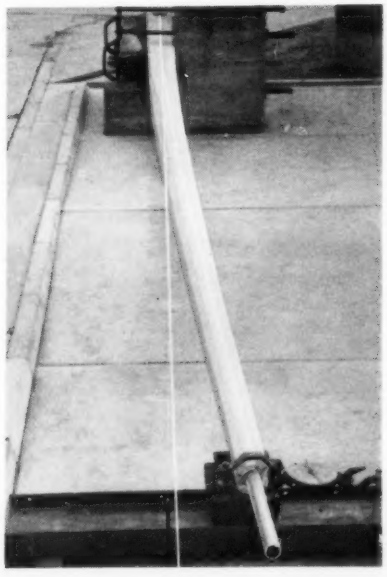


Photograph of one of many Stanton designs acceptable to the Ministry of Transport for use on trunk roads and approved by The Council of Industrial Design.



STANTON

Prestressed Spun Concrete Lighting Columns

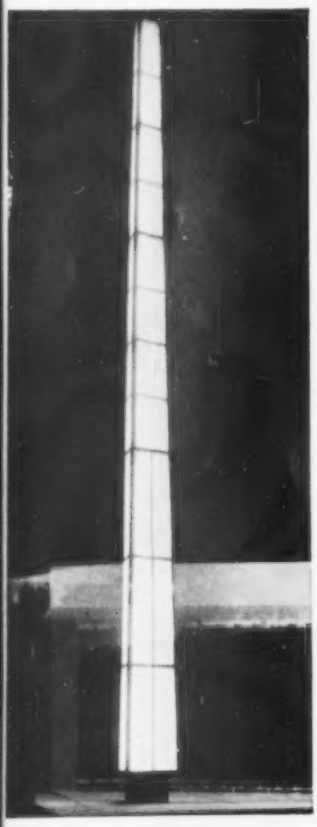
Stanton Type 8K Spun Concrete Lighting Columns at Belfast, fitted with Siemens Ediswan 'Corporation' 5-ft. fluorescent lanterns.

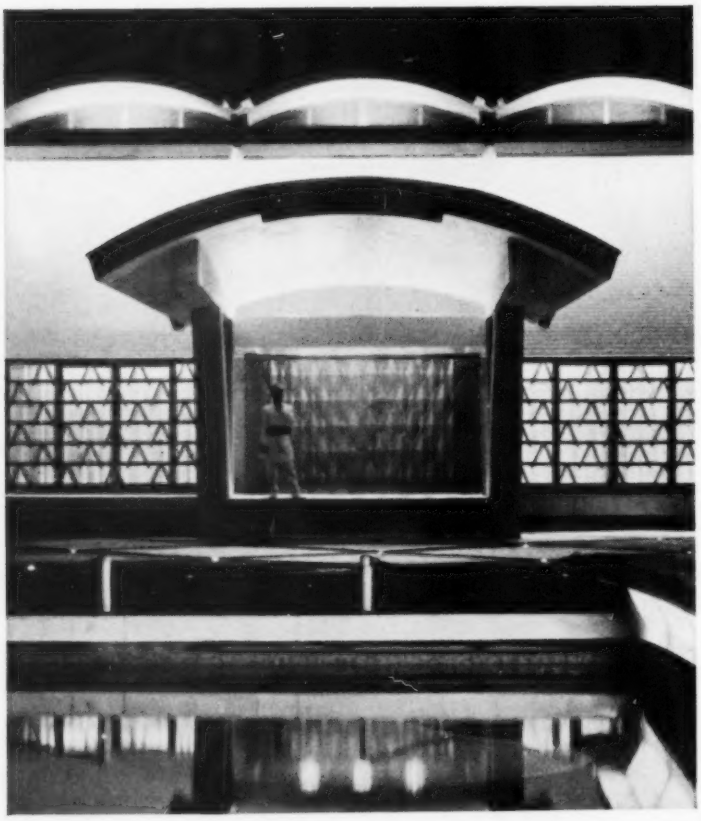
Photograph by courtesy of R. Watson, Esq., B.A., B.A.I., M.I.E.E., Belfast City Electrical Engineer.

Spun Concrete Column under a load of 1,092 lb. showing a deflection of 13½ inches. (The British Standard 1308:1957 proof test load is 320 lb.)

The Stanton Ironworks Company Limited Near Nottingham

A PALACE IN THE PERSIAN GULF





Architects : Farmer and Dark

From the lighting equipment of the world, Atlas Lighting was chosen to create an atmosphere of brilliance, originality and palatial splendour, for this magnificent 20th Century palace of the East.

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